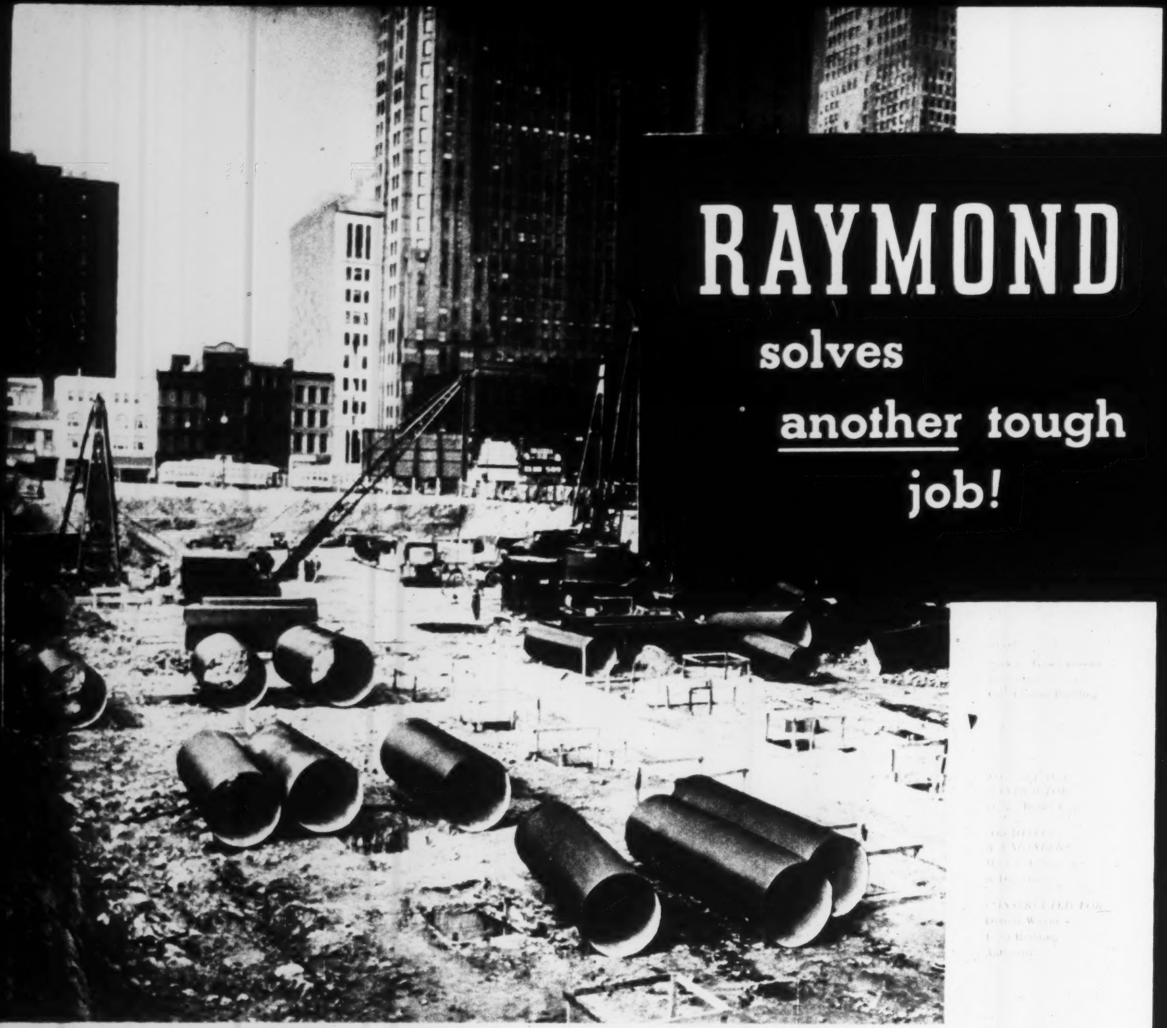
CIVIL ENGINEERING

ISABELA IRRIGATION DISTRICT, 1928
SOUTHWEST IRRIGATION DISTRICT, 1952
SOUTH COAST IRRIGATION DISTRICT, 1914
TUNNELS
HIGHWAY
YAUCO DAM

Newest water and power project in Puerto Rico is under construction by Puerto Rico Water Resources Authority. See article by Antonio Lucchetti.

Program for INTER-AMERICAN CONVENTION, SAN JUAN, PUERTO RICO, NOV. 12-15



City-County Building

ARCHITECTS & ENGINEERS

CONSTRUCTED FOR
Detroit Wayne
Joint Building
Authority

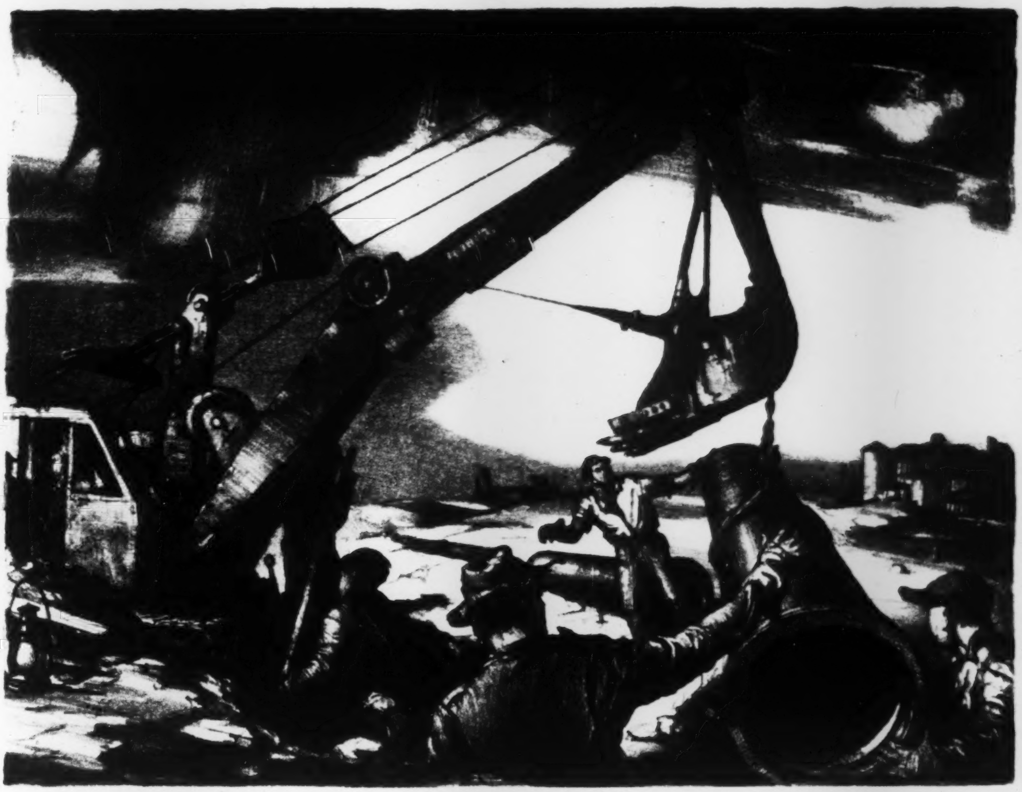
... **To provide** the foundation for the City County Building in Detroit's new Civic Center, Raymond placed 126 Gow caissons, with diameters of 48 to 74 inches, to depths exceeding 100 feet to hardpan. The caissons were belled out on the hardpan to varying diameters. Completion of this project ahead of schedule is another example of how Raymond engineers combine knowledge and experience with specially designed equipment to provide any type foundation anywhere. We would like to serve you on your next project.

RAYMOND CONCRETE PILE CO.
140 CEDAR STREET • NEW YORK 6, N. Y.

BRANCH OFFICES IN THE PRINCIPAL CITIES OF UNITED STATES AND CENTRAL AND SOUTH AMERICA

THE SCOPE OF RAYMOND'S ACTIVITIES . . .

Foundation Construction . . . Harbor and Waterfront Improvements . . . Soil Investigations . . . In Place Pipe Lining . . . Specialized Construction.



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

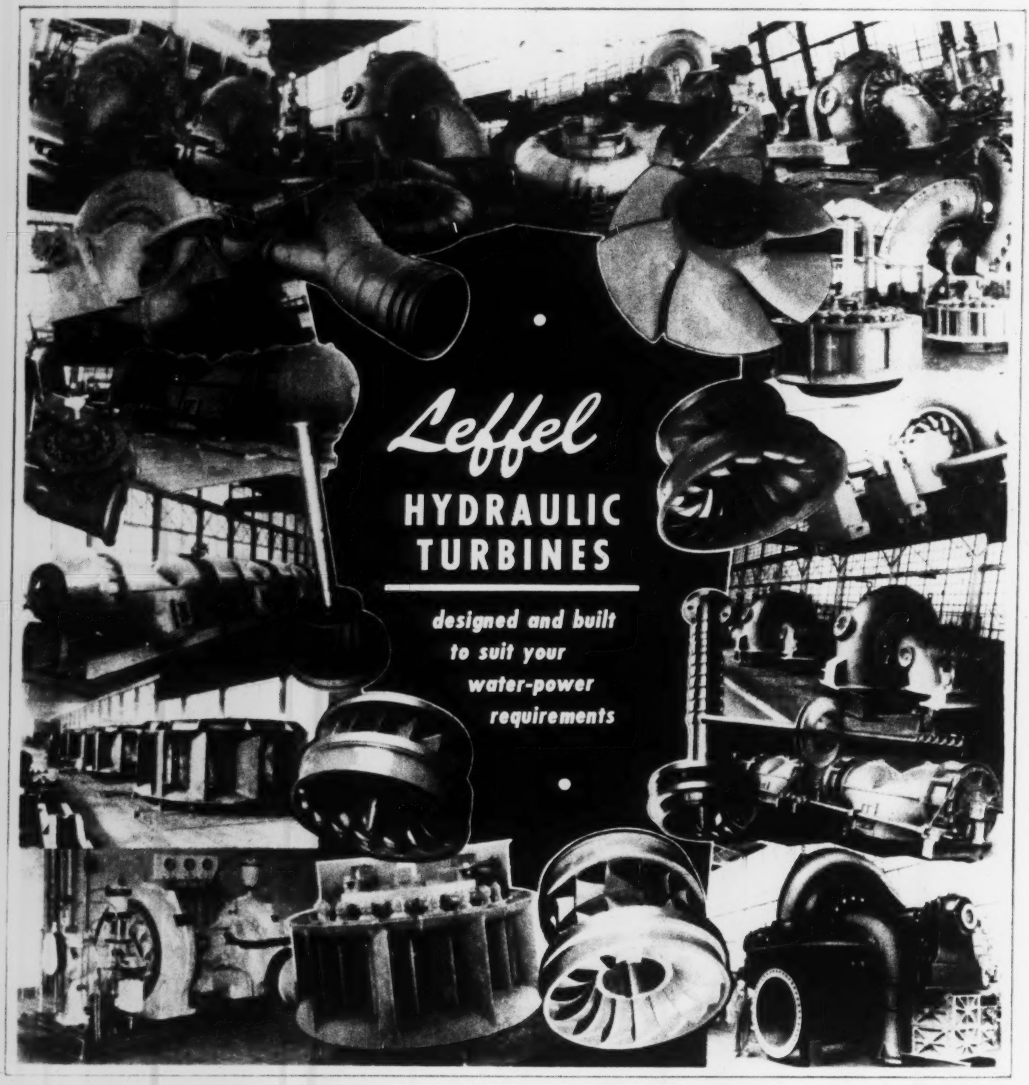
THIS RURAL SCENE is not an unusual background for cast iron pipe. The installation might be a water supply line for a city nearby. It could be a sewer force main leading to a treatment plant. Also it might be a gas transmission line for a city, in which case it would unquestionably be of the mechanical joint type.

U. S. cast iron pipe in sizes 2-inch through 24-inch are cast centrifugally in metal molds with bell-and-spigot; mechanical joints and plain ends. All sizes of flexible joint and integral flange pipe and all pipe 30-inch and larger are cast by the pit cast process. By whichever process the pipe is made, high quality is assured with the modern control methods employed during its manufacture.

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

U.S.
CAST IRON
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

CIVIL ENGINEERING, The Magazine of Engineered Construction, October, 1952. Vol. 22, No. 10. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930 at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.


Leffel
HYDRAULIC TURBINES
designed and built to suit your water-power requirements

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 90 YEARS

Start it...then walk away

IT'S THE GARDNER-DENVER 600

You don't need to "nursemaid" a Gardner-Denver 600 Portable. Just start it . . . then walk away. No eagle-eyed watching of complicated gadgets. No tricky controls to get out of order.

ANY compressor man can operate a 600.

ANY master mechanic can repair it in the field, when necessary.

ANY slope is okay for a 600—no need to keep it on the level.

Compare value before you buy—
and you'll choose a Gardner-Denver 600.

SINCE 1859

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

THE QUALITY LEADER IN
COMPRESSORS, PUMPS AND ROCK DRILLS

This is the pipe

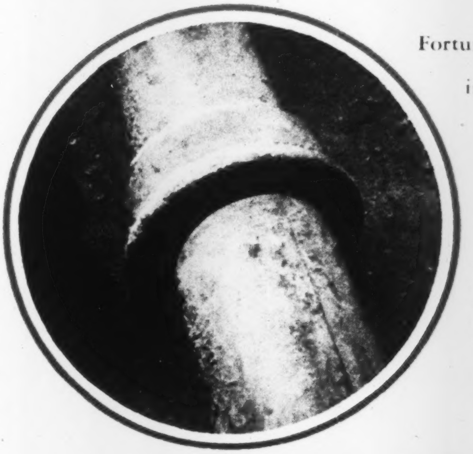
that's known as the

Taxpayers' Friend

To a tax-burdened public the statement that cast iron pipe is the "taxpayers' friend" is more than a mere figure of speech. To most waterworks engineers it is a cold fact. They know that cast iron pipe in water distribution systems has saved, and continues to save, millions of dollars in local taxes.

The useful life of cast iron pipe is known to be 4 to 5 times the average term of a water revenue bond issue. More than 35 American cities have cast iron mains in service that were installed over 100 years ago. A survey sponsored by three waterworks associations shows that 96% of all six-inch and larger cast iron pipe *ever laid* in 25 representative cities, is still in service.

Fortunately for taxpayers, over 95% of the pipe in America's water distribution systems is long-lived cast iron pipe—*the taxpayers' friend*.



This cast iron water main installed in Richmond, Virginia, 120 years ago, is still in service. Over 35 other cities have century-old cast iron mains in service.

CAST IRON ®

CAST IRON PIPE

America's No.1 Tax Saver

© 1952, Cast Iron Pipe Research Association

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

Paving the way for savings

● When you use asphalt construction or resurfacing for city street or highway, you're paving the way for real savings in time and money. When you use Standard Oil asphalt you're gaining even greater road building economy.

You save time because easier laying of asphalt, use of lighter and faster equipment, and the rapid setting of asphalt all help to speed road construction.

You save money because faster paving means fewer man-hours and lower labor costs. Local aggregate can be used to keep material and material handling expenses at a minimum. The durability of asphalt paving brings savings in the long run. Asphalt and heavy aggregate, mixed, make strong road foundations. Top courses of asphalt, stone, and sand present long-wearing, waterproof surfaces. Maintenance, when necessary, takes a minimum of time, labor, and materials.

You add further to these savings by using Standard Oil asphalt. With five asphalt-producing refineries located throughout the Midwest, Standard makes the haul to your site a short one. Prompt, reliable shipments eliminate work delays. Freight costs are at a minimum. A Standard Asphalt Representative will be glad to work with you on your job needs. For his services, write: Standard Oil Company (Ind.), 910 S. Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL
ASPHALT

STANDARD OIL COMPANY STANDARD *(Indiana)*

Chesapeake Bay Bridge, with Kent Island in background. Over-water portion of bridge is 4.03 miles long. Total length, with approaches, is 7.7 miles. Owner: Maryland State Roads Commission. Designers and Supervising Engineers: J. E. Greiner Co. Fabricator and Erector of Superstructure: Bethlehem Steel Company.

4-Mile Bridge Crosses CHESAPEAKE BAY

One of the spans being floated from erection point to final location. It is supported by falsework resting on one of the permanent simple truss spans which serves as additional falsework.

The final simple suspended span goes into place, lifted by four sets of falls. This same span was used as part of the falsework when other spans, like the one above, were floated into position.

This is the Chesapeake Bay Bridge, third longest bridge in the world, and the first ever to span Chesapeake Bay. The majestic 21,286 ft steel structure, located about 25 miles south of Baltimore, connects Sandy Point, near Annapolis, with Kent Island, Md. By linking the famous Del-Mar-Va peninsula to the mainland, it becomes a vital segment of the growing system of express highways along the eastern seaboard.

With its approaches, the 2-lane Chesapeake Bay Bridge is more than 7 miles long. It consists of 123 spans, ranging from 60-ft simple beam spans to a suspension bridge span which is 1600 ft from center to center of the main towers. The bridge includes deck girder spans, deck truss spans, deck cantilevers, and a through cantilever spanning 780 ft over a secondary ship channel.

The first span erected was a 300-ft simple truss deck span, located about a mile from the western shore. It was built on falsework bents adjacent to the permanent piers, and was then floated over the piers into position. During construction the span served as a permanent dock for the erecting and floating of other spans.

Throughout most of the bridge, span supports are rocker bents on low two-shaft piers, alternating with braced towers on low four-shaft piers. From each abutment the bridge deck rises approximately 175 ft to meet the suspension span. The maximum grade is 3 per cent.

The 30,000-ton superstructure for the Chesapeake Bay Bridge was fabricated and erected by Bethlehem.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL CONSTRUCTION

It's the Operators'

INTERNATIONAL DIESEL

BEST BY A DAM SITE. Troy Hood and Jack Rank (shown here with Dirt Foreman Sam Crawford) operate TD-24s for Guy H. James, building the great Oahe Dam in South Dakota. Hood says: "I can keep right behind the scrapers— catch 'em sooner and push 'em out faster because TD-24 controls are easier." And Rank chimes in: "Much easier to handle than any other tractor."

"ALMOST THINKS FOR ITSELF!" That's what Jess Leatherwood says about the Big Red TD-24 he operates for Macon Construction Co., Franklin, N. C. "It pushes more, moves it faster and handles easier than any other crawler I've ever been on."

"WE RIP PLACES YOU'D USUALLY HAVE TO BLAST," says another Macon operator, Roy Cantrell. "We've been working in the Blue Ridge Mountains on rock you couldn't touch with a dozer till the TD-24 came along. Now we blade where we couldn't scratch before, and rip where we used to dynamite!"

"OUR TD-24s REQUIRE LESS SERVICE," says John Tickler, Service Superintendent for John E. Bloomer Construction Co. "These big red machines are very accessible, very easy to maintain. And when we do need help, the International Distributor is always on the job!"

Crawler!

TD 24

Read what the operators and servicemen say about "Big Red", the International TD-24...

"HOW DO I LIKE 'BIG RED'?" asks George Miller. "Listen: This TD-24 is just the fastest and surest handling tractor there is, that's all! Nothing I've seen can touch it for moving dirt." George and his TD-24 move dirt in North Carolina for Kiker & Yount Construction Co.

"GREATEST THING I'VE SEEN," says Bruce Olson (right), TD-24 operator and Sec.-treas. of G. A. Olson Construction Co., Marshall, Minn. "The TD-24 is the easiest crawler of all to operate. The high-low shift is great for whipping around to the cut after dumping the load. It's the fastest equipment going for anything up to a 3,000-foot cycle!" Man in center is Glen Olson, Bruce's brother and company president. At left is Superintendent Donald Young.

Ask the men who know. Ask the operators. They know that *this* makes "Big Red" the Champ:

TD-24 POWER

148 maximum drawbar horsepower, more than any other crawler on the market.

TD-24 SPEED

Up to 7.8 m.p.h. with 8 forward speeds, 8 reverse. Moves loads faster, gets back quicker for more work-cycles per hour.

TD-24 STEERING

Fingertip control for pivot-turns, feathered-turns and *turns with power on both tracks.*

TD-24 STARTING

Exclusive International push-button starting for quick starts any time in any weather.

Want to know more reasons why the Big Red TD-24 is the work-champ of the world?

Ask your International Industrial Distributor. Ask TD-24 operators. Ask the men who know—and you'll be a TD-24 man yourself from then on in!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

SEE YOU AT THE POLLS!

INTERNATIONAL HARVESTER

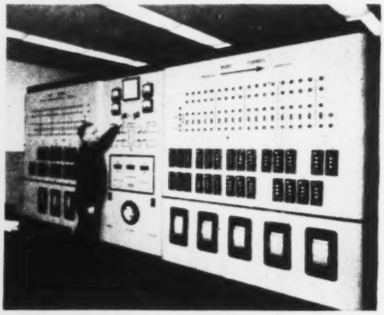
INTERNATIONAL

POWER THAT PAYS

ENGINEERING REPORTS:

CONTINUOUS-LINE FLUORESCENT LIGHTING key feature of Brooklyn-Battery electrical system gives safer, shadowless illumination. Variable light intensity and lower operating costs are other important features.

WELL-LIGHTED APPROACHES lead to tunnel. In daytime, lighting inside the entrance is brighter to provide better transition from sunlight.



CENTRALIZED CONTROL permits one man to operate the complete electrical system lights, fans, pumps and safety equipment.

Ribbons of light mean safer, lower-cost tunnel operation

Fluorescent lighting, central control, reliable power highlight G-E system at Brooklyn-Battery Tunnel

Now handling 16,000,000 vehicles a year with safety, comfort, and operating economy, New York's Brooklyn Battery Tunnel provides an excellent example of modern tunnel electrical systems. Designed by engineers of the Triborough Bridge and Tunnel Authority and General Electric, this electrical system was the first to feature economical, variable-intensity fluorescent lighting. Centralized control and a coordinated power distribution system also contribute to operating economy and dependability.

Tunnels are just one of the many types of heavy construction projects on which General Electric is ready to assist your engineers or consultants in electrical system planning. Contact your local G-E Apparatus Sales Office, General Electric Co., Schenectady 5, N. Y.

664-24

RELIABLE POWER a necessity for tunnels is provided by G-E metal-clad switchgear. G-E. also builds fan and pump drives for tunnels.

Engineered Electrical Systems for Heavy Construction

GENERAL ELECTRIC

"CATERPILLAR"

Auxiliary power tactics on the Cachuma Dam

Across the Santa Ynez River, seven miles southeast of Santa Ynez, California, the new Cachuma Dam furnishes domestic and irrigation water storage for Santa Barbara and surrounding agricultural areas. Built at a cost of $6,722,500, this earthfill dam measures 216 feet high and 3,000 feet long. Auxiliary power was used extensively to help speed its construction by Mittry Constructors, Los Angeles, who standardized on "Caterpillar" units for the purpose.

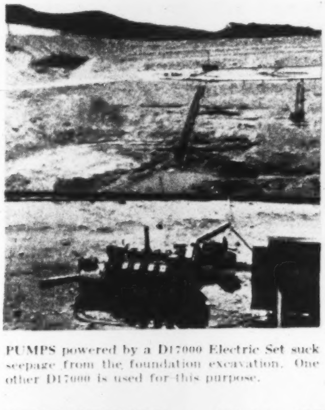
To keep the work moving after dark, Mittry set up floodlights in strategic areas. "Caterpillar" D4600 and D3400 Electric Sets operated these lighting stations, while two D3400s were used for lights and power in the carpenter shop. Assisting in the work itself, two D17000 Electric Sets furnished power for six electric pumps that drained seepage from the foundation excavation. And three "Cat" D13000 Engines provided power for compressors on drilling jobs.

Mittry also relied heavily on other "Caterpillar" equipment to push the project through profitably. Seven D8 and D7 Tractors with 'Dozers pioneered roads, leveled fill, cleaned up around shovels and draglines and served as pushers. And a No. 12 Motor Grader maintained haul roads.

FLOODLIGHTS for night work are powered by a "Caterpillar" D4600 Electric Set. Other lighting stations on the dam are also powered by reliable yellow units.

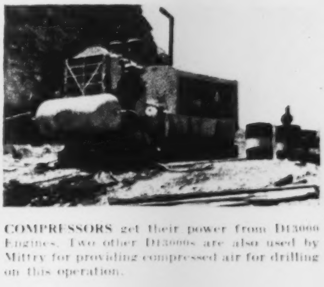
Standardization on sturdy yellow equipment has been proved profitable time after time by leading contractors. All units in the line—engines, electric sets, tractors, motor graders and earthmovers—function with a minimum of down-time under tough conditions.

Maintenance problems are simplified. And responsibility for service is centered in one organization—the nearby "Caterpillar" Dealer. With his stock of genuine "Caterpillar" parts and trained mechanics, he's an important factor in keeping units on the job. He is always available for service or information on "Caterpillar" equipment.



PUMPS powered by a D17000 Electric Set suck seepage from the foundation excavation. One other D17000 is used for this purpose.

LEVELING FILL, pioneering roads, acting as pushers and cleaning up are tasks done by this D8 Tractor with No. 8S 'Dozer. Six other big yellow 'dozers are on the job.

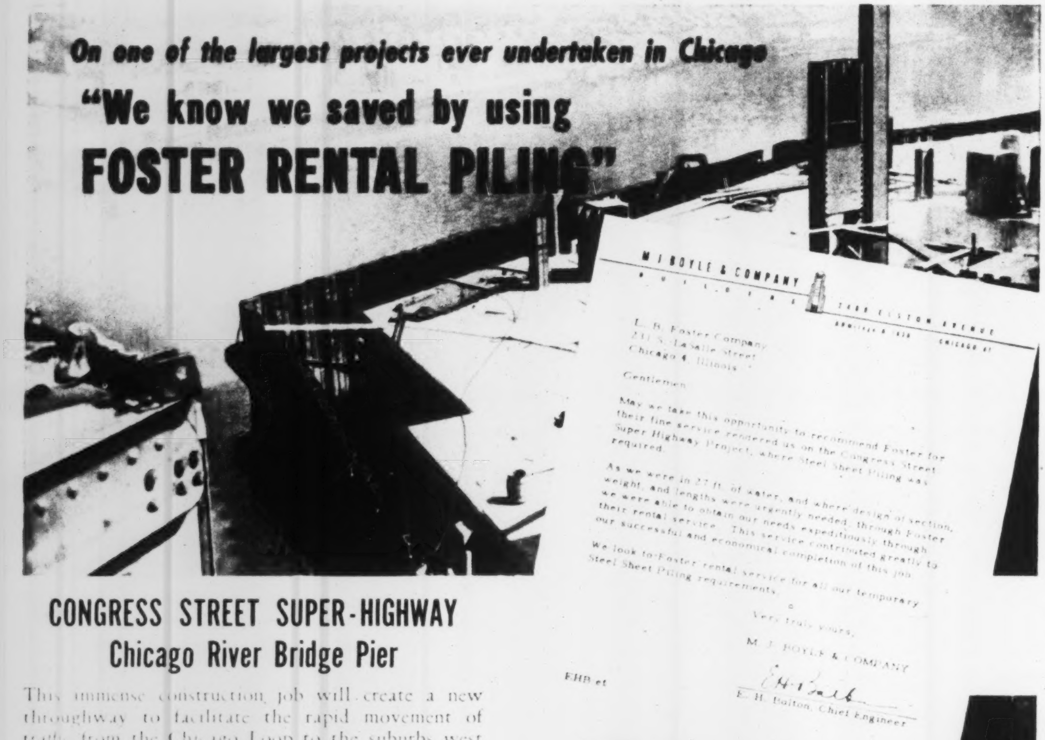


COMPRESSORS get their power from D13000 Engines. Two other D13000s are also used by Mittry for providing compressed air for drilling on this operation.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

On one of the largest projects ever undertaken in Chicago

"We know we saved by using FOSTER RENTAL PILING"



M J BOYLE & COMPANY
BUILDERS
2400 ELSTON AVENUE
CHICAGO 47

L. B. Foster Company
231 S. LaSalle Street
Chicago 4, Illinois

Gentlemen

May we take this opportunity to recommend Foster for their fine service rendered us on the Congress Street Super Highway Project, where Steel Sheet Piling was required.

As we were in 27 ft. of water, and where design of section, weight, and lengths were urgently needed, through Foster we were able to obtain our needs expeditiously through their rental service. This service contributed greatly to our successful and economical completion of this job.

We look to Foster rental service for all our temporary Steel Sheet Piling requirements.

Very truly yours,

M. J. BOYLE & COMPANY

E H Bolton

E. H. Bolton, Chief Engineer

EHB et

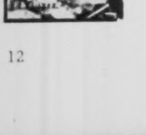
CONGRESS STREET SUPER-HIGHWAY
Chicago River Bridge Pier

This immense construction job will create a new throughway to facilitate the rapid movement of traffic from the Chicago Loop to the suburbs west of the city—will require four to five years for completion. Contractors M. J. Boyle & Co. realized that control of water seepage was a major factor and being able to get the correct steel sheet piling was a 'MUST'. So they turned to the dependable quality of Foster Rental Piling to insure accurate driving and kept water seepage to a minimum. Foster's immediate delivery of all the piling needed for this job definitely reduced costs for the contractors.

On your next job, depend on Foster for every piling requirement. You'll get the exact sections in exact lengths—in addition, Foster's standard low rental rates give you an advantage in competitive bidding. Pile Driving Hammers and Extractors also available.

TOP: Foster Steel Sheet Piling used in the construction of the reinforced concrete bridge pier located on the west bank of the Chicago River.

RIGHT: Accurate driving was made possible with top quality steel sheet piling (in the proper lengths and sections)—an exacting job kept seepage to a minimum.



• *Your nearest Foster office has this informative bulletin illustrating the uses and advantages of renting steel sheet piling . . . write or phone for Bulletin CV-10.*

RAILS • TRACK ACCESSORIES • PIPE • WIRE ROPE

L. B. FOSTER co.

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Here's all it takes...

for Easy–Safe–Sure
Remote Valve Operation

LimiTorque valve operation is the ultimate in ease and simplicity . . . just the pressure of a finger and LimiTorque will open and close valves up to 120″ diameter.

Think of the savings effected in time and money by eliminating men going from one valve to another, many of which are at distant locations—not to mention the time required to shut or open each valve. *LimiTorque Remote Control* not only prevents this waste, but enables one man to operate all valves from a central location and actually see on a panelboard whether the valves are open or closed.

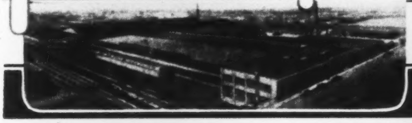
Various types are available for different requirements on all makes of valves: globe, gate, butterfly, plug, etc. *LimiTorque* may be actuated by any power source, such as electricity, water, gas, oil or air. Your valve manufacturer can supply LimiTorque Controls.

LIMITORQUE®

For details, send for our 96-page catalog, L-50.

LIMITORQUE CONTROL

Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK · PITTSBURGH · CHICAGO · HOUSTON · LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

On saved shifting time alone

YOU CAN GAIN UP TO 25

THE NEWEST, FINEST LINE ON EARTH!

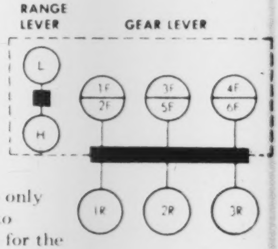
HD-5	HD-9	HD-15	HD-20
40 drawbar hp., 11,250 lb.	72 drawbar hp., 18,800 lb.	109 drawbar hp., 27,850 lb.	Hydraulic Torque Converter Drive, 175 ne engine hp., 41,000 lb.

PERCENT MORE PRODUCTION

WITH THE MODERN SHIFT PATTERN ON ALLIS-CHALMERS HD-9 AND HD-15 TRACTORS

It takes just half the time and effort to change from low forward to fast reverse with the Allis-Chalmers HD-9 and HD-15 transmission. This shifting time saved becomes production time gained on bulldozing and other jobs calling for a short forward-backward cycle. For example, job studies prove that on backfilling, pusher work, working around large excavators, digging and loading with front-end shovels — other jobs where frequent shifts are required — you can make five passes in the time usually required to make four... actually increase production up to 25 percent.

Here's how it works

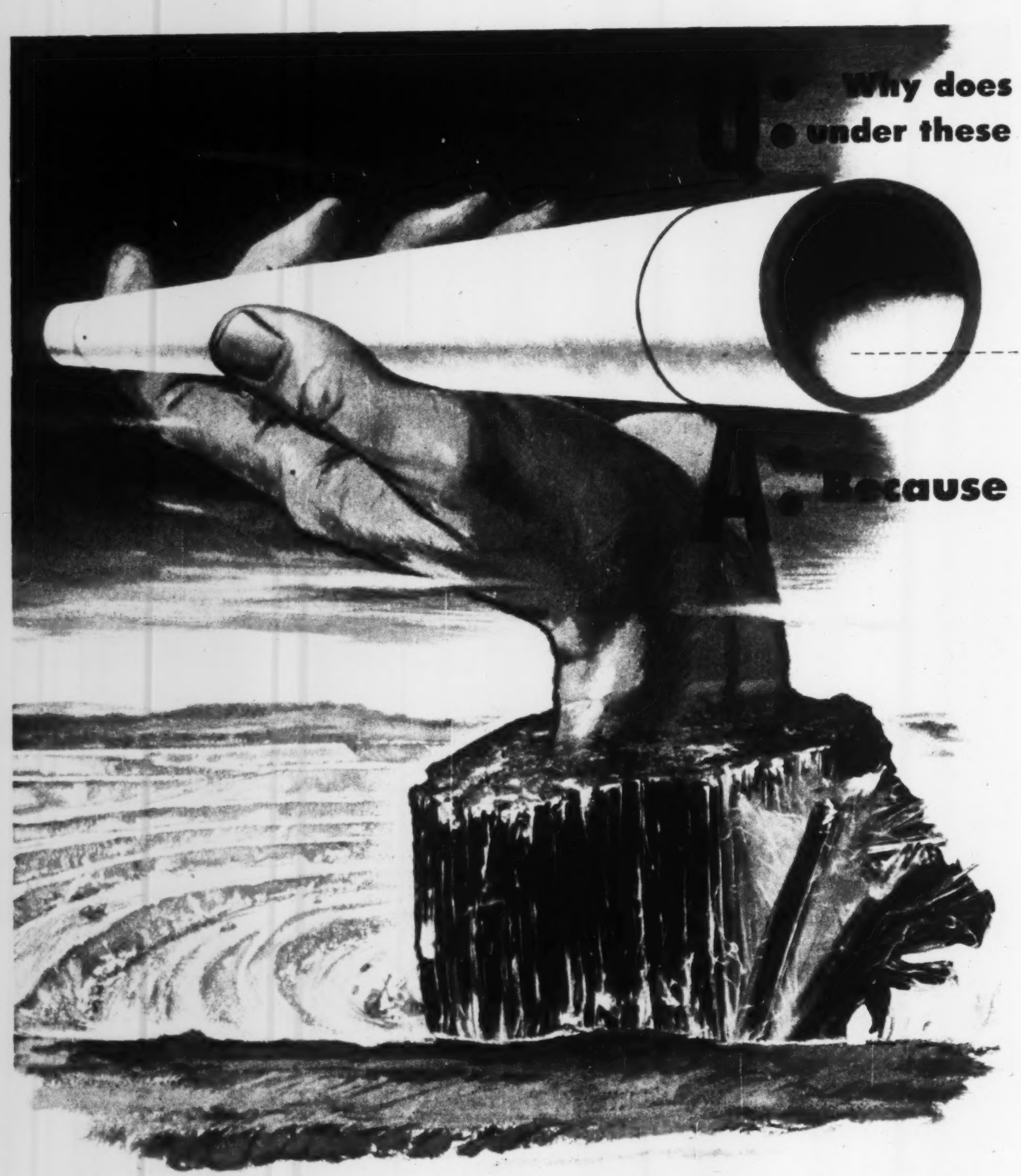


You go from any forward to any reverse speed with one simple shift of the gear lever. The only time you touch the range lever is to select the forward range you want for the job to be done — just set it and forget it.

The constant-mesh Allis-Chalmers transmission makes shifting smooth and effortless... without gear clashing. And it's so easy that the operator can *always* take advantage of high-speed reverse.

This exclusive shift pattern, together with all-steel welded construction, unit assembly, 1,000-hour lubrication, are just a few of the reasons you get more work done with the new *designed-for-your-job* Allis-Chalmers tractors.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.


Why does
under these
Because

*Transite is a registered Johns-Manville trade mark

Johns-Manville TRANSITE

TRANSITE PIPE last longer
West Virginia city streets?

Transite Pipe was first installed in this West Virginia city in 1935. In addition to heavy street traffic, it has withstood soil conditions so destructive that the pipe previously used had a service life of only two to three years. When the Transite main was recently uncovered to insert a tap into the line, the pipe was found in as good condition as the day it was laid!

it's reinforced with ASBESTOS
for lasting strength

THERE IS GOOD REASON why Transite* Pressure Pipe—shown in the city street above—has already far exceeded engineers' expectations for the service life of pipe used here:

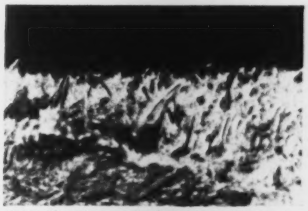
It's reinforced with tough, strong, indestructible fibers of asbestos—*the mineral that defies time!*

Countless numbers of these remarkably strong asbestos fibers—their tensile strength is comparable to that of steel—are dispersed uniformly throughout every length of Transite Pressure Pipe. This reinforced structure not only contributes to the *initial* strength needed in a pipe designed for use under busy city streets. Equally important, it helps assure the *lasting* strength that enables Transite Pipe to survive continued corrosive attack, year after year . . . to *stay* strong in service under conditions that are highly adverse to ordinary pipe materials.

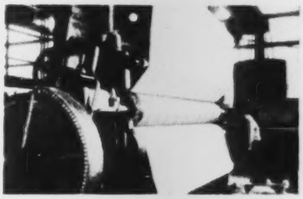
This quality of lasting strength is one of many important advantages of a pipe engineered with modern water transportation requirements in mind. Transite's Simplex Couplings reduce waterline leakage losses to a minimum, provide flexibility to help relieve the line of soil stresses and traffic loads. Its light weight makes for easier handling and effects substantial savings during installation. Its smooth interior assures a high coefficient of flow (C=140) and, because Transite can never tuberculate, helps keep pumping costs low through the years.

To find out more about how this modern asbestos-cement pipe can help solve your waterline problems and save you money, write Johns-Manville, Box 60, New York 16, N. Y.

JOHNS-MANVILLE
JM
PRODUCTS



This photomicrograph shows how the tough, strong asbestos fibers are distributed uniformly throughout the structure of the pipe.

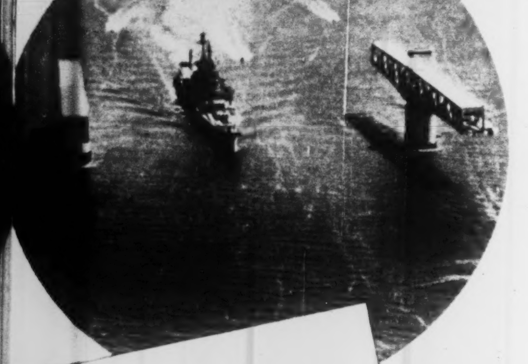


On machines like this, the asbestos-cement-silica mixture is "built up" under heavy pressure into a dense, homogeneous pipe structure.

Transite's flexible Simplex Couplings help relieve the line of excessive flexural stresses—an added safeguard against pipe failures.

asbestos-cement PRESSURE PIPE

World's largest double-leaf swing type bridge fabricated and erected by AMERICAN BRIDGE



THE George P. Coleman Memorial Bridge spanning the deep, swift York River between historic Yorktown and Gloucester Point, Virginia, is another engineering and construction triumph for American Bridge.

Resting on 220-ft. concrete piers extending 60-ft. above the water, this 3,750-ft. structure with its tandem swing spans is the largest bridge of its type in the world.

The superstructure, which is a combination of cantilever arms, deck plate girders, and suspended deck truss spans, has the extraordinary distinction of having two 500-ft. swing spans, each weighing 1,300 tons! Pivoting horizontally on piers 44-ft. in diameter, these unique spans swing open 90 degrees simultaneously to provide a 450-ft. freeway for the ample passage of even the largest U. S. fighting vessels.

The swing spans fabricated in the Roanoke, Virginia shops of American Bridge were erected in the open position. So well were all the phases of the work performed that when the bridge was closed, the three connecting points fitted together perfectly—again demonstrating the dependability of American Bridge construction.

INTERESTING FACTS

Total Length of Bridge	3,750	Weight of Each Swing Span	1,300 tons
Length of Each Swing Span	500'	Weight of Steel Superstructure	10,720,000 lbs.
Number of Shipping Pieces	5027 178 carloads		

Owner: State of Virginia, State Highway Dept.
Engineers: Parsons, Brinkerhoff, Hall and Macdonald, New York
Substructure Contractors: Massman Construction Co. Kansas City Bridge Company, Kansas City, Mo.
Concrete Subcontractor: W. F. Magann Corp., Portsmouth, Va.
Superstructure Steel and Steel Bridge Decking: American Bridge Division, United States Steel Company

AMERICAN BRIDGE
congratulates the
ASCE
on 100 years of
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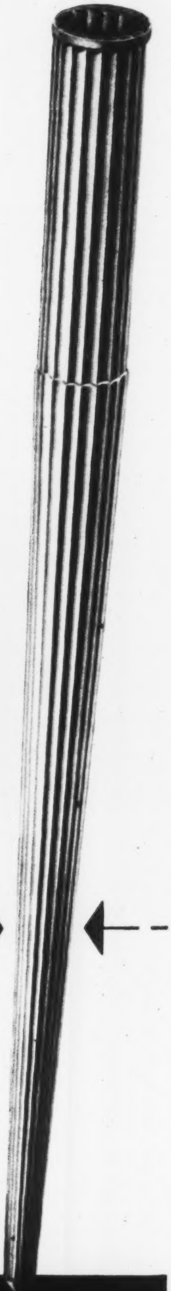

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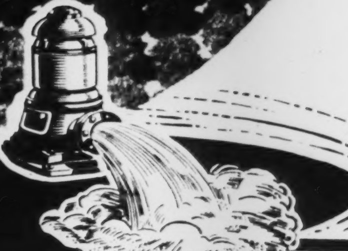

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Horton Penstock Installed at Bartlett's Ferry

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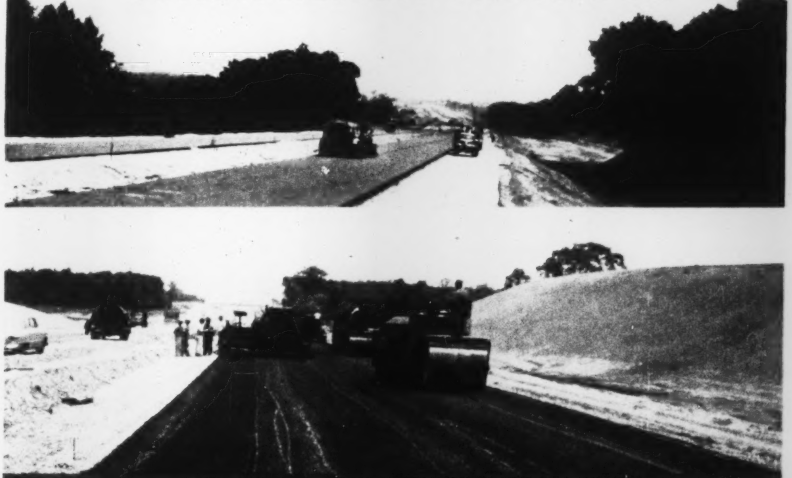
EFFECT OF DESIGN ON CONSTRUCTION COSTS

Coordinate design with construction methods



Debate over use of side forms on New Jersey Turnpike pavement led to one of changes in specifications made after contracts were signed. Contractors argued that side forms were impracticable and that, in view of rigid tolerances required, only logical way to build up macadam successfully was in three layers instead of two, eliminating side forms. This viewpoint won out.

W. W. WANAMAKER, M. ASCE, Chief Engineer, Orinoco Mining Co., U.S. Steel Corp. Subsidiary, New York, N.Y.

This article and the three that follow have been prepared from the papers presented by the authors in the symposium on Effect of Engineering Design on the Cost of Construction, before the joint session of the Construction and Structural Divisions, presided over by Lester C. Rogers, M. ASCE, at the Centennial Convention in Chicago.

All engineers and contractors who have been engaged in the design and construction of large projects have experienced the need for closer coordination between the theoretical considerations of design and the practical considerations of construction. Preplanning conferences have been held in certain instances with a view to effecting such coordination, and thereby reducing the number of changes in design and construction procedures which otherwise might be required.

One such conference was held in Bismarck, N.Dak., in 1946, when 35 contractors and construction equipment manufacturers met with the staff of the U. S. Engineer Office to exchange views on how best to initiate the job of building Garrison Dam on the Missouri River, the largest rolled filled dam in the world. More than eighty representatives of industry, engineers, contractors, and equipment builders devoted the better part of three days to these conferences. At that time there were various practical questions to be answered, such as whether to initiate construction by the award of relatively small contracts in conformity with the limited funds available, what should be the magnitude and scope of subsequent contracts and the period of time necessary for the preparation of bids; whether contractors should finance their own equipment purchases; and what would be the classification of materials to be excavated and whether they should be used in the earth fill. Although subsequent developments indicated that these conferences accomplished little, chiefly because what could be done was largely determined by the annual appropriation made by Congress in succeeding years, nonetheless the meetings attracted the leaders in their respective fields, and the time spent together in frank discussion resulted in associations of mutual advantage. As a result of these conferences, some contractors evidently concluded that they would not be interested in bidding. Such decisions, when wisely taken, are as important to the success of the industry as a whole as, in other cases, is success in selling a qualified contractor the idea that he should bid.

Some of the difficulties that can arise in carrying out plans and designs will now be discussed with particular reference to lessons learned on the New Jersey Turnpike. This turnpike, a 118 mile toll express highway crossing the state, was constructed from January 1950 to January 1952, at a cost of approximately $255,000,000. It is pertinent to refer to a few modifications of design which came about directly or indirectly because of the recommendations of contractors presented after the contracts were awarded.

Contractor's Suggestions on Turnpike Paving

One of the most important decisions made in the construction of the turnpike was the selection of type of pavement. A paving committee of seven engineers, one selected from each of the seven firms of consulting engineers engaged in the design and supervision of construction of the turnpike, was organized and, over a period of about eight months, made an exhaustive study of rigid and flexible types of pavement. It concluded upon a design of each, and considered that either would produce a satisfactory and safe riding surface, of ample strength and durability. After competitive bids were received and evaluated, it was decided to adopt the flexible type for the entire turnpike.

The design of the flexible pavement called for a 6-in. pervious non-frost-active subbase; two 3-in. layers of waterbound macadam and one 2-in. layer of penetration macadam to comprise the base course; and a surfacing consisting of 4½ in. of asphaltic concrete to be placed in two courses, the first 2½ in. thick and the surface course 2 in. thick. Crushed stone was specified for all macadam courses. Side forms were to be used to assure a sharp edge to the pavement and a smooth riding surface.

The adequacy of design was checked against all applicable engineering data and experiences. The waterbound macadam was recommended because it was considered adequate to support the design load, a 36,000-lb axle load, and because the cost data the committee assembled indicated that a penetration macadam of equivalent thickness would be more expensive.

Soon after the award of the paving contracts, one of the contractors proposed a substantial modification in design. This contractor had just completed construction of a flexible pavement for the New Hampshire Turnpike, which had been designed by one of the consulting engineers engaged on the New Jersey Turnpike.

He recommended the substitution of a 7½-in. penetration macadam base course laid in two courses, one 4½ in. thick and one 3 in. thick, in lieu of the two 3-in. waterbound macadam courses, and the one 2-in. penetration macadam course. He agreed that the reduction of ½ in. in the total thickness of the base courses should be made up by increasing the 6-in. thickness of the underlying gravel subbase to 6½ in. He proposed to use 3.2 gal of asphalt per square yard in the base course, in lieu of the 1.6 to 1.8 gal per square yard in the basic design. In addition, he offered a credit of 10 cents per sq yd as a reduction in his contract price for paving. Within a short time, the other paving contractors made similar offers. It was concluded by the turnpike engineers that the design should be modified to conform to the contractors' proposal.

The contractor who initiated the revision of design based his recommendations on his construction experience, which indicated that penetration macadam would provide a construction haul road immediately after the first course was laid, and that the continuing use of this road by heavy construction equipment during the remainder of the construction period would be of advantage to him, and also to the New Jersey Turnpike Authority, since such use would expose any weaknesses in the subbase. He realized also that the tolerances specified by the turnpike engineers, which required that the final base course be brought within ¼ in. of established grades (that is, plus or minus ⅜ in. in 10 ft for the bottom courses, and plus or minus ¼ in. in 10 ft for the top course) and with the size of aggregates specified, would be costly to meet on each of three successive layers. He felt further, although he did not openly express himself on this point, that it would be next to impossible to maintain such tolerances, especially during and after periods of bad weather.

Elimination of Side Forms

The original specifications required side forms and two asphaltic concrete courses 2½ in. and 2 in. in thickness respectively. The pavement contractors asked that this be modified, by eliminating the side forms and laying the asphaltic concrete in three courses, each 1½ in. thick. They contended that the side forms were impracticable, and that the only logical way in which to meet the rigid tolerances required by the Turnpike Authority (within ⅛ in. in 16 ft and within ¼ in. of true cross section for the final surface course) would be to build up the material progressively in three layers. Although the turnpike engineers felt that elimination of the side forms would benefit the contractors to the extent of 50 cents per sq yd, negotiations were finally concluded to accept this proposal also, with no reduction in the contract price.

There was considerable debate over the question of side forms, their advantages and costs. Some held that these forms were required to insure that the pavement would have the desired riding qualities and meet the specified tolerances. However, it should be borne in mind that forms were proposed for use only along the outside edges of the pavement, which is 24 ft wide for most of the turnpike length and 36 ft wide for a considerable distance, and that it was not intended to use forms at the center of the 24-ft pavement or at the interior joints of the 36-ft pavement because their use would require a cold joint. When it was argued that

ABOVE, LEFT. Use of metal expansion joints on bridges on New Jersey Turnpike illustrates one of problems in coordinating design with need for speedy construction. Metal end dam, in foreground, caused delays in fabrication and erection. In numerous instances regular erection crews would not install it and special crews had to be assigned. Final decision, made in order to complete project on time, was to omit armored expansion joints on a group of bridges, except at abutments, and substitute cork type. ABOVE, RIGHT. Another difficulty in carrying out design of New Jersey Turnpike arose in connection with 6-in.-thick gravel subbase specified over hydraulic sand fill in Jersey Meadows section. Contention of contractor, Gull, Tully & De Napoli, that gravel would be unstable was found warranted and traprock screenings, a quarry by-product, were substituted.

it was of even more importance to attain minimum tolerances at the center and intermediate points in the width of the turnpike, and that only the outer edge of the customary 12-ft paving machine would be able to ride a form, the answer was that 24-ft-wide paving machines could be used. But to the writer's knowledge, no such paving machine was contemplated by the contractors, and none is in commercial production by the industry, at least to any extent, for the placing of asphaltic concrete surfacing.

Obviously many features of the pavement design remained unchanged. Nevertheless it was rather surprising that after the thorough study made by the special committee, and the review of the results by other engineers, the pavement proper and the manner of placing it were altered substantially because of the practical proposals of contractors, submitted before actual work was started and shortly after the contracts were awarded.

So far as is known, all concerned with the construction of the turnpike are satisfied with the pavement as built according to the contractors' recommendations, and believe it to be at least as good as that originally designed. However, the dollar savings which resulted from the negotiations conducted after the contracts had been signed, were comparatively inconsequential. No one can predict what those savings might have been had competition been sought on the pavement as finally laid, a much more attractive proposition from a contractor's point of view than that contemplated in the original design.

Side-Slope Drainage Structures

Another modification of design came after the turnpike had been opened to traffic. This concerned the protection of side slopes on fills. The specifications provided that no drainage would be installed to protect such side slopes, although it was required that they be top-soiled and planted. The contractor on one section of the turnpike argued at length, and at times vehemently, that the Authority could not expect to hold these slopes without drainage structures except through excessive expenditure of maintenance funds, and that the contract should be modified to provide gutters and flumes leading down the slopes. His advice, although borne out by experience elsewhere, was ignored for a long time. It is understood that not only on his section, but on many other fills along the turnpike, his practical suggestions, to a substantial degree, have now been adopted.

A considerable part of the northern section of the turnpike is located through the low meadow land prevalent in the area. Here the subgrade was built up with a fine sand, dredged from Lower New York Bay by hopper dredges, and placed by hydraulic methods. The specified gravel subbase of 6-in. thickness was to be placed on this fill. The contractor contended that the gravel would be unstable and unsatisfactory if used, and urged that a trap-rock screening, produced as a by-product of quarrying operations along the Hudson River nearby, be substituted. After some experimentation, it was found that his view was well founded and his solution of the problem was adopted. The screenings were also used to construct the shoulders. Although some difficulties have been experienced with the latter, for reasons which need not be elaborated on here, all concerned appear to be satisfied that the screenings provided a superior subbase on which to construct the penetration macadam surfacing.

Expansion Joints Simplified

The standards established for the construction of expansion joints in the concrete decks of bridges and viaducts along the turnpike called for the use, on the small bridges, of armored bulb angles. A series of bridges were constructed through the city of Elizabeth, N.J., involving 15 individual bridges, carrying the six lanes of the turnpike over city streets. Most of the bridges consisted of two abutments and two intermediate piers carrying three non-continuous steel spans.

The fabrication of the armored expansion joints was comparatively complicated, inasmuch as these joints were required to conform to the vertical and horizontal curvatures of the turnpike, and to meet the rigid tolerances for the pavement. The war emergency first made it difficult to obtain the steel, and to find fabricating shops that could construct the joints in time. Overcoming these difficulties caused so many delays that there was little time left for installation. Then difficulties with labor were experienced by the contractor. Certain erection crews engaged in the construction of the steel work would not install the end dams and other armored joints, and some reorganization of crews was necessary for this purpose. The Authority was finally faced with either postponing the opening of the turnpike, which would have had such a drastic effect as not to be countenanced, or eliminating a number of the armored expansion joints and substituting some simpler type of joint. In the interest of completing the project on time, it was decided to use a cork type of expansion joint of conventional design over the piers, and to eliminate the armored type except at abutments.

Although the turnpike has been in use for only a comparatively short time, there appears to be no evidence that the simple expansion joint will turn out to be inadequate. In this instance, the change in design came about because the engineers recognized the danger of delays, and these circumstances perhaps could not have been foreseen. On the other hand, the overall schedule for construction of the project was so rapid that the avoidance of time-consuming installations, some of which might border on extravagance (extravagance in time at least), was from the start an obvious necessity.

Coordinated Effort Needed

The examples cited give some basis for the belief that there is, in many instances, a lack of coordinated effort between designers and constructors. These examples have been pointed out without purpose of criticism. It seems unnecessary to record that each of the engineers who played a part in the striking success of the New Jersey Turnpike occupies a prominent position in his field, and enjoys the respect and admiration, not only of those who worked in close association with him during the construction period, but also of the profession as a whole. The sole purpose here is to point out the need for improving a situation which seems to call for improvement.

In the work in which the writer is now engaged, it is necessary to coordinate the design with mill facilities for rolling structural steel shapes. It is too easy to specify sizes that are infrequently rolled, or sizes of reinforcing steel that are difficult to procure. Yet such sizes can easily be changed in most cases by changing design spacings. In normal times the designer bases his selection solely on engineering principles, but now, when speed on construction is of paramount importance, his decisions must give added weight to the latter consider-

Develop cooperation between

The effect of engineering design on the cost of construction is a subject of vital importance to the contractor, to the engineer, and to the client they mutually serve, the owner. It is a problem of many aspects and one that can be discussed at great length from any one of those aspects, but for the purpose of this discussion it will be treated as seen through the eyes of the contractor.

The client's interest is basic, of course. Reputable engineers and contractors, in addition to their mutual responsibility to the client, have an additional long-range interest in building a reputation for keeping costs to a minimum, for the lower costs can be held, the greater is the encouragement to those considering construction programs.

The effect of engineering design on construction costs, from a contractor's viewpoint, can best be analyzed as a two-phase problem. One involves the costs that are written into the plans and specifications as they are handed to the contractor. The other involves the variables in costs which result after performance begins.

First let us review the precontract phase, a phase in which the contractor has no voice whatsoever.

At the inception of a project, the engineer is engaged by the owner to draw plans and write specifications covering its construction. Presumably the engineer has many conferences with the owner so as to incorporate his wishes into the finished drawings. In most instances the engineer has adequate time to obtain sufficient information in the field on which to base his design, and to prepare a set of drawings and specifications which will be fair both to his client (the owner) and to the contractors who will be invited to submit bids.

Unless otherwise stipulated, the contractor must take it for granted that the engineer's plans are complete and definitive, and that the specifications are descriptive enough to set ation. It is a crude simplification, but nonetheless true, to state that the engineer should first visit the mills and warehouses and then begin to put the design on the drafting boards.

There may be reasons, professional or otherwise, why engineers do not desire to consult with contractors' organizations or with manufacturers prior to completion of design. They may already know, or have ways of learning, or have in their organizations, all the practical knowledge of field engineering and construction procedures that is pertinent to the job. Perhaps there is the feeling also that construction superintendents, for example, are beneath professional notice. On the other hand, we know that reputable and successful contractors generally have in their own organizations fine engineering personnel and sound advice available for the asking.

It is my conviction that prospective bidders do not always read the specifications thoroughly before bidding and, I might add, that they seem never to fail to memorize such specifications before a contract is completed. These circumstances, coupled with the inevitable conflicts between plans and specifications, and between various provisions of the specifications, lay part of the framework for claims and disputes.

Prebidding Conferences Helpful

Prebidding conferences on fundamentals, such as basic field construction practices and practicable work schedules, should resolve some of these problems. It is believed that such conferences would save money for owners by clarifying uncertainties and hence reducing to a minimum the indirect costs which prospective bidders must include in their bids to cover uncertainties and unknowns. Such procedures also should reduce the number of change orders that must be issued, and no one engaged in the construction business can be so naive as to believe that an owner can negotiate a very shrewd bargain once a contract is signed.

Too frequently engineering plans and specifications are brought to completion with one's thoughts solely on the final results and the finished product, and with little serious and experienced attention given to how the project or phase of the work is to be constructed by the contractor.

The examples above point out in part the results of the constructors' approach, what *they* have wanted, and what *to them* was important in the building of the project. It is this failure, when the drawings, construction schedules, and specifications are being prepared, to visualize the manpower, machinery, and equipment actually at work, which in large measure gives rise to poor planning, lost time, and expensive design. Here between the separate fields of design and construction there still exists a gap, in some cases a chasm, that should be bridged.

engineers and contractors

RALPH E. DeSIMONE, President, Merritt-Chapman & Scott Corporation, New York, N.Y.

forth precisely what the owner has in mind. In the interest of his client, the engineer usually prepares an estimate of cost which later is used for purposes of comparison with the bids received.

Contractor May Be Invited to Review Design

In some instances contractors are invited to review the design for friendly criticism, before bids are invited. This is an excellent procedure and no indication of weakness on the part of the designer. Many contractors carry competent engineering staffs of their own, as well as experienced field men, and are in a position to offer constructive criticism of the design and make suggestions on its adaptation to economical methods of construction. The designer thus is aided in envisaging the construction problems involved, and can design accordingly.

For example, on a bridge contract with multiple two-shaft piers, the batter on the pier shafts was different on every pier. Since one of the most important items of cost on any construction contract is that which involves the making, placing and stripping of concrete forms, it is evident that the added cost of readapting forms to the different batters, or providing a separate form for each pier, might easily be considerable.

In another instance a building was to be constructed in a sandy water-bearing soil, with the subgrade about 30 ft below the natural water table. The structure was so designed that it had to be fully completed, including the superstructure, before it could be backfilled and water permitted to touch its outer surface; otherwise it would prove too buoyant. A slightly larger projection of the footing would have eliminated the possibility of buoyancy, and a few extra reinforcing rods carried from the footing to the outside of the walls would have simplified the construction of the wall, thus eliminating a considerable part of the construction bracing which otherwise was required. A redesign of this structure to incorporate these features would have saved in construction costs considerably more than the cost of the added materials.

Still another instance concerns the construction of a substantial steel sheetpile bulkhead. The contractor pointed out to the designer an inherent weakness in the design, which showed the wales on the tie-rod system that anchored the bulkhead, welded to the inside of the sheetpiles. He warned the designer that there was danger of bulkhead failure by chain reaction if one of the welds failed during backfill operations, but the warning went unheeded, with the result that a substantial part of the bulkhead collapsed as predicted, and the whole job had to be redesigned and reconstructed. The reconstruction cost greatly exceeded the entire cost of the original job.

Where Does the Trouble Start?

After the plans are completed they are made available to the various bidders. In determining his bid price the contractor studies the plans and specifications, analyzes the design, checks quantities, and in cases where there may be obvious doubt as to the intent of the design, may seek conferences with the engineer for clarification. On the basis of his experience and judgment with relation to the particular type of project, the contractor then arrives at an estimate of cost, adds his profit margin and contingency, if any, and submits the resulting figure as his bid. If the bid is accepted, it represents the initial estimated cost of construction.

Up to this point everything has proceeded in an orderly manner. Now the trouble, if any, starts. Designs are usually of a high degree of excellence. In many instances, however, they do not show all the details and are not flexible enough to be easily adapted to whatever changed conditions may be encountered in the field.

Supervision Is Critical Area

The translation of design into construction under field conditions is the critical area where the cost of construction may be increased or decreased—usually increased. That costs more often go up than down is frequently due to the fact that the application of the plans to site conditions too often is left to interpretation by inexperienced field representatives. These representatives frequently lack practical experience in working out problems with contractors so as to find an alternative construction satisfactory to the contractor and at the same time meeting all the practical requirements of the plans and specifications.

I sincerely believe that the interpretation of plans and specifications by supervisory inspection personnel is the principal factor which creates controversies, causes delays, and increases costs. As a matter of business practice, contractors find it necessary to hire the best help available, regardless of cost. Construction men hired by contractors as project supervisors must have many years of practical field experience behind them or they will not be considered for the job. Similarly, in my judgment, it is the responsibility of the engineer to assign to the project site field representatives who are qualified in every respect to move the job forward regardless of the day-to-day problems that are bound to arise concerning the interpretation of the plans and specifications.

To the contractor it appears a paradox that the engineer will assign the best brains of his organization to design an economical structure and then entrust the supervision of its construction to field representatives of limited experience. In asking for field representatives who are "qualified in every respect," I am asking for men who will have both the ability and the authority to make binding on-the-spot decisions when the occasion demands.

Frankly I feel that many field representatives do not conscientiously work to help the contractor get a better, faster job for the owner, but rather exercise what might be called "police action." They appear to work on the premise that if a contractor is not carefully "policed" he will do something wrong.

I, for one, hope never to be faced with the type of problem encountered by some contractors, who have such forebodings as to the undue severity with which the representatives of certain engineering firms will interpret the plans and specifications, that they add an extra percentage to their estimates when figuring on jobs to be supervised by those firms.

Contractor Tries to Do Good Job

Reputable contractors take a fierce pride in doing a good job under all sorts of handicaps. As a matter of economical operation—to facilitate their own planning and scheduling—they are as desirous as the engineers of following the plans and specifications to the letter when field conditions permit. When field conditions interpose obstacles, a solution fair to both parties must be reached quickly and efficiently if construction costs are to be held in line.

For example, I have known of contracts that specified pile supports where field conditions proved they could not be driven; of cases where piles of a definite length were stipulated and they proved too short by as much as 50 ft. In a period of critical material shortages, such problems could easily cause a job to be long delayed, with substantial increases in costs, unless practical interpretation of the plans and specifications permitted a prompt remedy, by the substitution of alternative construction.

Some years ago, when I was managing the New England operations of our company, I kept in our yard at New London a few specimens of piling that had been overdriven at the insistence of inspectors. Whenever controversies arose in the field about the overdriving of piles, I would invite the engineers to take a look at my collection of "grim reminders."

My own experience with steel H-piling indicates that this is one of the toughest items of cost in any construction contract. On one particular job I saw the entire profit margin disappear because it proved impossible to drive piles of the lengths specified, and the specifications were so written that the contractor could not be reimbursed for cutoffs, most of which ran into substantial lengths.

I have also observed contracts involving tremie seals in cofferdams or caissons in the middle of a waterway where field representatives insisted that multiple tremies be used, even though it was physically impossible to surround the structure with sufficient equipment to handle the tremies properly. Eventually this particular problem was straightened out, and it was proved by tests that the contractor's judgment as to the number of tremies was correct, but only after some delay and added construction costs.

For over 36 years I have been connected with the construction industry as a contractor and it has been my happy privilege to discuss engineering and construction problems from the contractor's viewpoint with many of the finest engineering firms in the United States, and I am glad to say I number among my best friends many of the leading members of these organizations. This only came about from a mutual respect—one for the other—in endeavoring to solve construction problems of interest to both.

I am also proud to say that during

my long contracting career I have been associated with projects undertaken and completed under the direction of these capable engineering firms with practically no friction. If these comments accomplish nothing else except to emphasize the importance of this mutual respect, of sitting down together when problems arise in an endeavor to solve them in an honest and practical way, I feel that I shall have contributed a great deal to the construction fraternity.

Recommendations for greater economy in construction

1. The engineer, in preparing his design, should constantly keep in mind the methods to be used by the contractor for economical construction.
2. The engineer should be responsible for the accuracy of borings and other subsurface data shown on the plans.
3. Engineering plans should be complete and definitive, and still be kept sufficiently flexible so that they can be adapted without loss of time and, if possible, without increases in cost, when changed conditions are encountered in the field.
4. Interpretation of plans and specifications in the field should be entrusted by the engineer to supervisory personnel who have had practical experience with contractors, who understand the contractors' methods of obtaining results, and who have binding authority to make decisions.
5. Regularly scheduled field meetings should be held between the engineer and the contractor's representatives to discuss various phases of the work so that both parties can be of mutual assistance when problems arise.
6. Where separate, specialty designs are involved, they should be thoroughly coordinated in advance, with field conditions in mind.
7. It should be remembered that a design that appears most economical from a purely design standpoint may actually be most costly if it entails the development of special construction methods.

Examples Illustrate Value of Cooperation

A few examples may be of interest. During the early stages of my work in the field I acted as superintendent for a contractor on the installation of a large outfall sewer. This contractor had been asked to take over the project from a previous contractor who had failed.

The earlier contractor had been doing a good job when he reached the point where it was impossible for him to follow the specifications, which required that he lay the heavy concrete pipe by supporting it on blocking resting on soft bottom. After several unsuccessful attempts to lay the pipe in the specified manner, he protested that the blocking was not feasible for soft bottom. He then requested permission to lay the pipe on a pile foundation, with payment for the additional cost. His request was denied. As a result he faced the alternative of supplying the pile foundation at his own expense or giving up the job. He gave up the job, sustained a terrific loss, and was driven into bankruptcy. The contract was given to us with instructions to lay the pipe on a pile foundation the only practical method by which the work could be accomplished.

Contractor's Suggestion Accepted

As an example of a different type of procedure, I will cite a large bridge contract where, after the award was made, the contractor sat down with the engineers and suggested an alternate design for a large anchorage pier, based on the availability of certain materials in a critical period of shortages. The suggestion was accepted by the engineers, with the final result that costs for that part of the work were held within the amounts set in the contract, plus a considerable saving in construction time.

This is the type of enlightened engineering that should be available when the occasion arises. It should be remembered that, for the owner, construction costs mean not only the money but the time spent on a project. The time element is particularly important on a revenue bond project, like the case just cited, where early completion actually permitted an earlier start in collecting tolls.

One of the greatest difficulties a contractor experiences is lack of coordination of the design as a whole, especially on certain types of building projects. Some of these projects are highly specialized, involving a number of diverse skills architectural, structural, mechanical, electrical, and others. Yet it often appears to the contractor that there has been little attempt to coordinate the various designs involved in the overall structure.

Aside from all the uncertainties entailed in his bidding, the contractor who receives such an award is confronted with what amounts to a redesign and coordination of the work so as to be able to proceed with construction. This invariably results in considerable delay, and often in very considerable financial losses to the contractor.

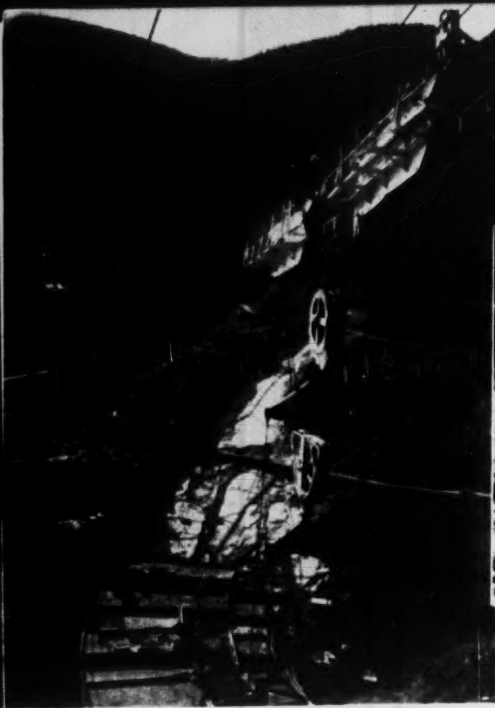
Ambiguities Cause Trouble

On one such contract, the ambiguities and discrepancies in the various designs were staggering. In addition to receiving hundreds of revisions in the drawings, the contractor was issued nearly 1,000 letters of clarification that involved several thousand items and resulted in several hundred change orders. As a result progress was slowed to a snail's pace. Materials could not be ordered far enough in advance of the need; certain materials that were ordered and received had to be reworked; certain specified materials simply were not available.

Special Designs Costly

There are also instances of structural designs which, while very economical to erect from a purely design point of view, actually entail the development of special construction methods and consequently result in heavy additional expense.

In conclusion, may I congratulate the American Society of Civil Engineers for having made this subject the topic of a symposium. The subject matter is controversial and perhaps provocative, but I hope these remarks will be received in the friendly spirit in which they are given. Public discussion of a constructive nature offers the best approach to eventual solution of any problem, and cannot help but benefit everyone concerned.



Construction economy

One economy measure on Hungry Horse Dam is use of lean concrete in interior under surface layer of richer concrete. Concrete is placed by system of four cableways stretched between towers on sides of canyon. Dam is scheduled for completion in 1954.

Reclamation construction is controlled by the dictates of economy in greater degree than most other types of construction. The basic law requires that its beneficiaries, chiefly the irrigators under reclamation works, repay the cost of these works. As these irrigators have only a limited margin of profit from their farming operations, the repayment obligation imposes an onerous burden. From the earliest days of the Reclamation organization its engineers have therefore given intensive study to designing for minimum cost, and many examples of outstanding design and construction economy will be found in the works of even the years immediately following the inauguration of reclamation work in 1902. In recent years the pressure for construction economy has been increased by steadily mounting price and cost levels and by the changing nature of reclamation tasks.

Modern reclamation construction has to deal with much larger and more complex developments than those of past decades. The available construction sites and other controlling conditions are less favorable, and today each new project calls for extended comparative studies to find what layout, type of design, and details will involve the lowest cost consistent with efficient service.

It is conceded that the requirements of quality and economy are closely related, and that our increasing use of site and material exploration, structural analysis, and physical investigation tends naturally toward lower cost as well as more efficient service. Engineering design by its very nature aims at economy as well as adequate service.

Uniformity Cuts Costs

The cost of a structure comprising a number of elements is increased if the several elements differ in form, size and details, or if the manual or machine procedure involved must be varied. Conversely, economy is favored by uniformity of design and adaptation to a minimum number of craft processes. In applying this well-known truth we of the U.S. Bureau of Reclamation have made increasing use of standard designs, both for works built in place and for manufactured machinery and equipment. In contrast to early practice in reclamation construction, which favored individual design of each structure or plant to fit the particular conditions of the case, we now recognize design standardization as an important aid to economy.

Hundreds of standard design sheets developed over the years but utilized only to a limited extent are being drawn into regular service, after bringing them up to date if necessary, in the light of operating experience and other changed conditions. Such structures as canal turnouts, trashracks, roadways, radial gates, are especially adaptable to standardization. Large gates and valves are among the exceptions to the application of standardization, and power and pumping plants obviously require special design, as they must be fitted to the particular conditions of the individual case.

The value of uniformity has been recognized by modifying designs of concrete structures to reduce form costs. Unnecessary diversity has been reduced by drawing up a limited list of standard reinforcement shapes for normal design. At the same time many details of reinforcing steel were simplified, as by reducing the extent of use of hooks and the length of laps at splices. Adoption of the new high-bond reinforcing bars contributed to making these economies possible.

When defense needs limited the supply of certain materials, it became necessary to adapt designs to the use of readily available materials and sizes. In many instances substitutes for critical materials had to be used. Supply limitations in some cases affected construction economy

is basic in Reclamation design

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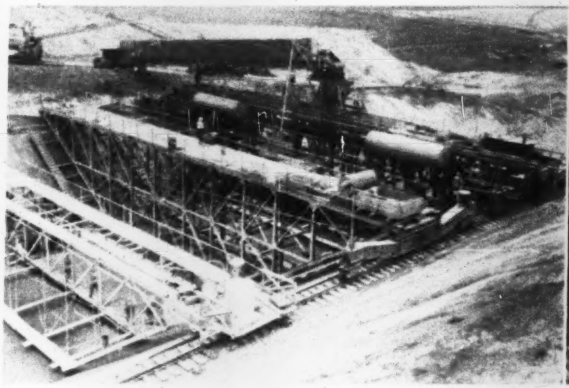


Canal specifications are prepared to facilitate use of excavating and lining machinery. Above, curing jumbo (at left), finishing jumbo, and slip form are at work on Delta-Mendota Canal in California.

Practice of utilizing local soils for earth dams is fundamental source of construction economy, as is also use of modern construction machinery. Earth dams are the rule in Great Plains area, where Cedar Bluff Dam, shown under construction (above), is located.

by threatening to delay the completion of urgently needed works, such as power plants, and here it was necessary at times to expedite construction by paying overtime, by diverting materials from one job to another, and by other expedients of the kind. While such expediting added to immediate costs, it saved money in other ways. A power plant was enabled to earn earlier power revenues, which paid many times over for the extra cost incurred in early completion.

Simultaneously with design modification of the kinds indicated, improvement in concrete design resulting in construction economy was realized through increasing knowledge of cement properties and concrete production, including the selection and grading of aggregates. The improvement of quality which accompanied the cost reduction was supplemented by better knowledge of material properties and stress analysis, thus paving the way for the adoption of increased working stresses. Concrete working stresses in dams and other structures have been raised to 1,000 and 1,350 psi respectively with corresponding gains in economy, while steel stresses have been increased to 24,000 psi.

Paralleling the advancement of design, construction requirements have been modified to provide economy consistent with satisfactory service results. A particularly significant modification was the establishment of dimensional tolerances for concrete construction. This, coupled with the elimination of needlessly expensive concrete finishes by a carefully defined schedule of finishes for each specific element or surface of a structure, had an important influence in reducing construction costs.

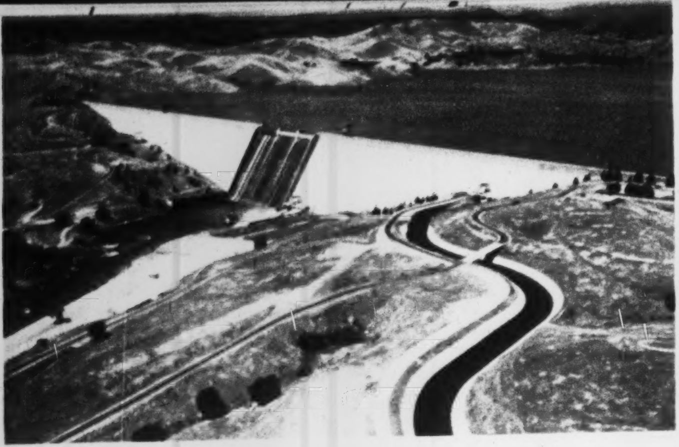
The adaptation of designs to economical use of construction machinery received much study. Canal dimensions were studied to determine those best suited to efficient use of canal excavating and lining machinery. Uniform wall-panel sizes and column dimensions in buildings were specified where applicable. Designs for concrete structures in all cases were developed with a view to form simplification and maximum reuse.

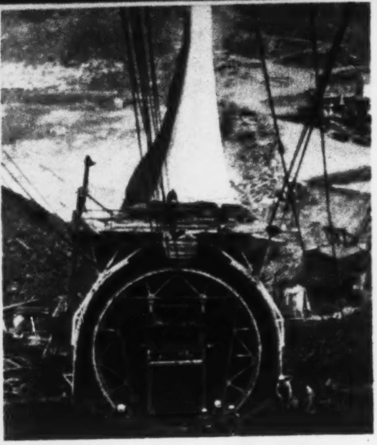
Concrete and Earth Dams

The specialized problems of designing large concrete dams have offered many possibilities for construction economies in recent years. Thus, as a result of stress analysis of concrete-arch and curved gravity dams by the trial-load method, it has been found that in many cases the cross-section and mass of a structure can be reduced materially. Accumulated stress observations on large dams, including Hoover, Grand Coulee and Shasta, support this conclusion, as the observed stresses agree closely with the results of the trial-load stress calculations. The volume of concrete in several recently designed arch dams has been reduced by an amount approaching 15 percent, an economy that will amount to millions of dollars when these designs are put under construction.

Economy of another sort is being obtained at the Hungry Horse and Canyon Ferry dams through the use of a lean concrete in the interior, (2 cu ft of cement per cu yd), under a surface layer of richer concrete. At the same time both dams make use of pozzolanic admixture and air entrainment, for the combined purposes of improving the workability of the concrete mixture, assisting in saving cement, and controlling destructive chemical effects.

Although developed more than 20 years ago, block and slice construction of concrete dams continues to improve, with gain to both structural quality and economy, as does the associated practice of cooling the concrete after placement and subsequently integrating it into a monolithic structure by grouting the contraction joints.





Leading subject of economy efforts in recent years has been canal lining. The two canals issuing from Friant Dam in California (above), are Friant-Kern Canal on near side of spillway, and Madera Canal on far side. These canals are recent examples of coordinated design and construction for economy. High-head siphons have also been studied intensively for cost reduction. Reinforced-concrete pipe lined with thin steel water-retaining shell has found use on large scale. Most notable development of this type is great Soap Lake Siphon (above) of Columbia Basin Project, built-in-place structure 22 to 25 ft in diameter about 2 miles long. Saving in first cost as compared to steel pipe was $2,700,000. Increasing use of laboratory research must be credited with large

Development of earth dams has been no less progressive. Evolution of the Bureau of Reclamation practice of zoned earth-dam construction has led to design and construction refinements, a great increase in the use of earth dams, and more economical construction. The basic practice of utilizing, to fullest extent, the local soil materials, including the required excavation, is a fundamental source of construction economy. Although initial site exploration usually gives complete information on the kind and quantity of local materials, the zoning of the dam is modified during construction whenever required to fit the materials actually found, for maximum economy.

Study of hydrostatic and flow conditions in earth dams and their foundations has also produced construction economies. Use of pore pressure measurement has assisted in detecting drainage deficiencies, and increasing the stability of the embankment. In certain cases, where underflow conditions justified, it became possible to reduce the scope of foundation cut-offs. By controlling embankment compaction to realize the design conditions in full, it is now possible to assure the security and permanence of even very high earth dams at reasonable cost. Improved knowledge of foundation conditions under earth dams also makes it possible to economize by selective grouting instead of complete foundation grouting.

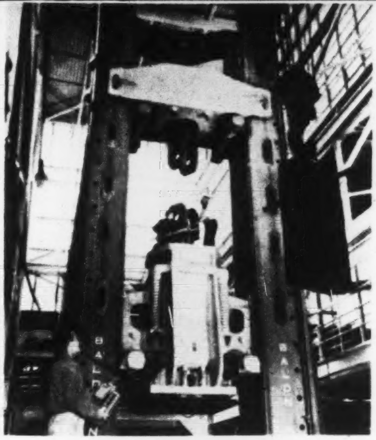
Developments of this kind, assisted by full utilization of laboratory soil tests, a thorough system of field test control, and constant reliance on soil mechanics, has led to steady reduction in the construction costs of reclamation earth dams. The proportioning of spillways to assure safety against overtopping in floods has also furnished opportunities to economize by restricting the service spillway to floods of moderate size and providing an emergency, or in effect a fuseplug, spillway to pass high flood volumes. This type of construction is of course permissible only where the geologic conditions and the topography make it compatible with permanent safety.

In considering earth dam construction, it is important to keep in mind the profound influence of modern construction machinery and practices on costs. Excavating machines, transporting equipment, and compaction rollers not only give assurance of obtaining virtually perfect embankment construction under a wide range of physical conditions but have demonstrated that the work can be accomplished at a speed and efficiency that heretofore seemed wholly beyond attainable limits. Without the assistance of the improved construction art, the designer's efforts at economy would have been decidedly limited.

In other fields also, extensive progress in construction economy has been realized by reclamation designers. Improved canal design has contributed to economy in many directions. Standard canal specifications, the proportioning of canal widths and arrangement of structures so that construction equipment can operate to best advantage, have been prominent factors in saving unnecessary expense in construction. Within the past two years, omission of reinforcement in the concrete lining, except at those special locations where reinforcement is indispensable, has become another large factor in economy. Designs have been simplified for construction by eliminating warped transition structures in the majority of cases.

A leading subject in recent years has been canal lining. Increasing recognition of the injurious effect of seepage from canals has led to the development of special instruments to test soils along canal lines, as an aid in forecasting the need for lining. Extensive study has been given to designing and trying out in practice various new types of lining, lower in cost than the thick reinforced-concrete linings of former practice. With the development of linings of asphaltic membrane and asphaltic concrete, compacted earth and silted earth, the overall costs of both main canals and laterals have been significantly reduced. Much still remains to be done in this field, but first cost is now and will continue to be a controlling guide.

Among special conveyance structures, high-head siphons have been studied extensively for possible cost reduction. Reinforced-concrete cylinder pipe—that is, reinforced concrete precast or monolithic pipe lined with a thin steel water-retaining shell—has found use on a large scale. Its most notable development is the great Soap Lake Siphon of the Columbia Basin project, a built-in-place cylinder pipe structure 22 to 25 ft in diameter and about two miles long, operating under hydrostatic heads as high as 225 ft. As compared



contributions to reduction of reclamation costs through development of more effective designs and materials. The 5,000,000-lb-capacity Universal testing machine shown above is in Denver laboratories of Reclamation Engineering Center.

with steel pipe, the alternative type of construction, this siphon saved $2,700,000 in first cost and will save large additional sums annually in reduced maintenance cost.

Perhaps more study has been given to designing for economy in the field of power and pumping plants than in any other field of reclamation design. Every plant designed in recent years has undergone intensive study of varied alternatives of layout, frame design, walls and roof, to arrive at the lowest cost of construction. According to the availability of materials, the adopted designs provided for a reinforced-concrete frame and walls; a riveted steel or welded steel frame with walls of concrete, brick or fabricated panels; and a roof of concrete, timber or precast panels, for minimum cost. In numerous cases the advisability of an underground plant has been studied looking toward economy as well as security.

Other Factors of Economy

Parallel with design improvements, several other factors have contributed progressively to reduction of reclamation construction costs. Improvement in construction skill and equipment, already mentioned, must be recognized as one of the leading factors. Development of better materials through the constant efforts of industry in cooperation with our engineers and testing experts is another important element of economy. The increasing use of tests and laboratory research must also be credited with large contributions to the reduction of reclamation costs. While this subject is too broad for detailed coverage here, special mention should be made of the wide use of hydraulic model study and of such special arts as chemical and petrographic analysis in aiding the evolution of highly efficient designs at minimum cost, and in developing materials capable of serving reclamation operations more satisfactorily.

Finally, the development of modern specification and contract practice calls for recognition as a factor in lowering construction costs. Development of standard specifications was one of the earlier steps toward cost reduction. However, specification improvement has gone on continuously and extensively for a number of years, reducing the contractor's risks and thereby the cost of his operations. Unnecessarily severe requirements imposed by past design practice have largely been eliminated, and closer cooperative relations between designer and contractor have been established.

Specification Improvements Cited

A few specific items of specification improvement that contribute to cost reduction demand mention here. It has been made regular practice in our specifications to define the sources of materials in detail. Where several contractors are required to work simultaneously, the scope of their respective responsibilities is carefully defined, with a view to eliminating confusion, overlaps, and omissions. More thorough information on the construction site and subsoil, based on extended advance exploration, furnishes better definition of the contract requirements.

The contractor's risk has been reduced by dividing major schedule items that are subject to possible increase or decrease of quantities into a basic quantity and a possible added quantity, so that by covering his distributive costs under the first item he will be secure against loss in case of reduction and yet can do any added work at the lowest possible price. On some large jobs, provision has been made to pay the contractor for the major items of his fixed plant.

Contracts have been subdivided to permit greater competition and to limit the effect of delays. Progressive payment for river control operations has been specified in a number of cases. Excavation classification has been simplified where feasible, and overhaul requirements have been placed on the basis of mile-yards in lieu of the old-time station-yards. Finally, under the current material-control conditions, full priority information is included in specifications wherever necessary. By these and similar means, the cost of construction both to the contractor and to the Bureau has been reduced, work has been speeded, and cooperative relations have been maintained, all in the interests of ultimate economy.

Economy in Both Design and Construction

To summarize, it may be said that reclamation design, in its evolution through experience coupled with analysis and test, has always given full consideration to costs. Design did not stand alone in the advance of construction economy, however, but was powerfully aided by the development of improved construction tools and machinery and by the construction industry's remarkable growth in capacity and skill. Refinement of specifications and contract practice supplemented these developments.

The combined effect of these factors is to produce lower-cost reclamation works of greater service value and permanence. The progress of the past decade, which is especially notable, must be credited in large part to the unprecedented volume and complexity of reclamation construction, combined with the pressure of rising price levels as a compelling motive for cost reduction.

It is not possible, unfortunately, to report how much the cost of reclamation construction has been reduced by the design and auxiliary efforts outlined in the foregoing. However, a few items are known in terms of dollars. The Delta-Mendota Canal, built without the originally contemplated reinforcement, showed a saving of nearly three million dollars. Hungry Horse and Canyon Ferry Dams, by virtue of reduced cement proportions, saved more than five millions. The bold reinforced-concrete conduit design of Soap Lake Siphon cost $2,700,000 less than the best alternative structure. But these single economies are only incidental.

The overall effect of many years of designing for construction economy is composed of the progressive reduction of contract bids and payments, and these are not amenable to comparison because of the varying nature of the work and the local conditions. It is safe to say, however, that tens of millions of dollars have been saved in the cost of reclamation construction, and that future reclamation will profit by additional millions of savings annually, secured through continued attention to costs and by coordinating the objectives of the designer with those of the construction engineer.

Train design engineers in construction

The volume of future construction depends largely on the extent to which engineers are able to develop new processes which will make existing plants obsolete. In these days of spiraling costs, it also depends on their ability to provide structures that will be competitive, on the basis of invested capital, with those built before the depreciation of the dollar. Thus, the challenge to the industry is to find more economical means of construction, and this economy must start in the design office.

Maximum economy of design requires a careful consideration of all the factors that may affect the final result. For example, in the case of a bridge, the distribution of traffic from the approaches is as important as the structural design. In an industrial plant, the most efficient assembly or production line is essential. The charges against plant and equipment, included in the final product of a factory, must be such that the owner can successfully meet competition on this item. Careful consideration should be given to location, transportation, availability of materials and equipment, and availability of both skilled and common labor. For example, as labor has become more costly and less efficient, a premium has been placed on designs that can be carried out with greater use of machines and a minimum of labor. On the other hand, on a dam in Asia, cement might be so expensive and labor so cheap that the usual design considerations would be inapplicable.

While the importance of these broad aspects of design is recognized, my subject here is restricted to the responsibility of the designer where the layout of the plant or structure has been fixed and the problem is to develop details of design to conform to a predetermined master plan.

This problem may start with the designer himself. The ideal designer would have a complete knowledge of all branches of engineering theory. He would be acquainted with all the technical literature dealing with problems similar to the one with which he is faced. He would be abreast of the immense amount of engineering research. He would be thoroughly familiar with construction methods and construction equipment. He would be able to visualize all the steps between the general concept of the project and its completion. He would weigh, carefully, the various construction materials that are available and adopt those most economical for the purpose, after giving proper consideration to such questions as appearance, durability, and maintenance. He would analyze

Value of simplification and duplication as means of securing economy is illustrated by General Accounting Office Building, Washington, D.C. Architectural simplicity and great number of repetitive units were important factors in holding cost down to about $1.00 per cu ft, including architectural and engineering services

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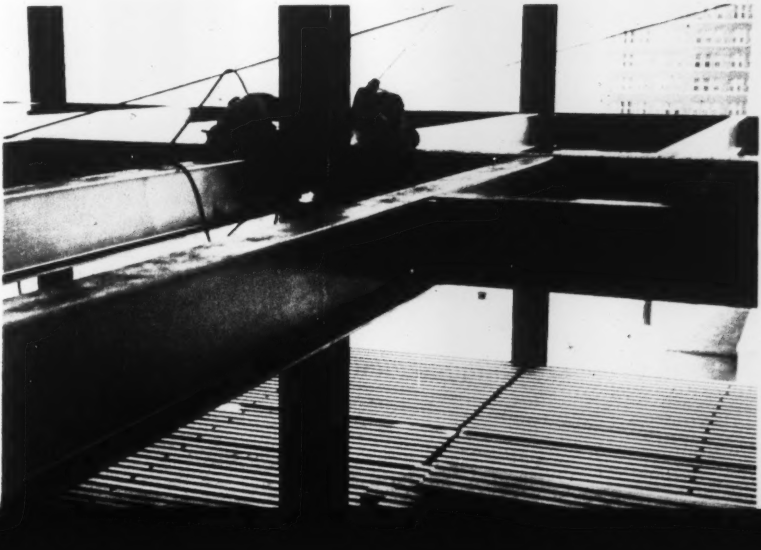
realities

the various construction operations involved and assure himself that all would be feasible and that equivalent results could not be achieved more economically by other methods. Unfortunately men meeting these specifications are not readily available.

It is the rule in the construction industry to do one's utmost with the material, equipment and labor available. Frequently, outmoded equipment is rebuilt or remodeled on the job to meet the given conditions. In these days of a shortage of engineers, when the younger graduates are being upgraded rapidly, we must do our best with the material at hand. These circumstances place on the younger men the responsibility of doing their best and on the supervisors that of providing adequate supervision and training.

The obligation to provide training for the younger men rests on the

For economy, design should be based on most efficient use of construction equipment. Generally large units, such as Lorain dragline and other Diesel-powered Caterpillar units shown, are more economical than small ones. This equipment made 10 trips an hour on ¼-mile haul on Mississippi levee.



New methods and processes should be used where applicable and economical. Use of welded frame for multi-story buildings in Texas has shown appreciable savings.

industry as a whole. Our profession needs far-seeing elder statesmen who will, first, resist the present-day tendency toward selfishness, and second, strongly emphasize the importance of long-range planning in passing good counsel along to young engineers.

Valuable Lessons Taught by Experience

It is not logical to give our future designers meticulous training in higher mathematics and engineering theory and then fail to furnish the lessons taught by experience which cannot be found in textbooks. It is a pity that so many mistakes in design, the record of which is buried by the pride of the designer, are not made known to others. Younger men coming along repeat the same errors since no record of the mistakes made by their predecessors is available.

This matter of errors in design deserves more attention than it generally receives. With the few exceptions of major failures, engineering literature records only successes. More information about minor failures would enable the designer to avoid similar weak spots in his own work. Rarely is any project completed without a minor failure, or at least questionable details, resulting from faulty design. These minor failures or faulty details are not caused by high stresses from the forces considered during design but rather from the designer's failure to recognize certain conditions that may be present or from his failure to make a common-sense analysis of the forces existing during construction or in the completed structure.

The incompetence or carelessness of the designer should not be included in the factor of safety. Economical design requires that the various structural components be proportioned using unit stresses higher than those commonly used. The writer has been connected with two experimental investigations on recently completed structures. In both cases the most important conclusion was that the design was extravagant.

As part of the young engineer's training, it is desirable that the industry do more to encourage experience in both construction and design. The designer should have a thorough knowledge of field practice such as the building of forms, placing of concrete, fabrication and erection of steel, and the use and limitations of heavy equipment. Likewise, it would be a help to the construction engineer to understand some of the reasons why, for example, reinforcing steel should be placed in the positions indicated by the drawings.

Engineers in charge of any design should realize that, by their approval of a drawing, they certify that the construction shown thereon is safe and is the most economical solution for the given problem. Within limits, speed in construction leads to economy. A short construction period reduces financing charges. In the design office, however, speed is possible only after the general plan has been laid out and complete information is available. Nothing is more destructive to morale in the office, or on construction, than continual changes. As professional men, designers should resist pressure which calls for a finished product without providing sufficient time to produce the best results.

Closer coordination between the designer, the estimator and the constructor would produce economies. Opportunities for economy would become apparent if the designer were to make a detailed estimate of his proposed design or, better yet, have the opportunity to make detailed estimates of alternate designs. Similarly, discussions between the designer and the constructor generally indicate changes which facilitate and reduce the cost of construction.

At this Centennial, all of us should acknowledge our debt to our predecessors who have raised the construction industry in this country to a standard never before approached. All that has been said here can be summarized by the advice that we do our best to prove worthy of our profession and to maintain the high ideals already established.

Some General Suggestions for Economy

1. **Duplication.** Throughout the layout and the detailed design, duplication of members, concrete forms and other components will reduce cost. Frequently such duplication will justify the use of considerable additional material.

2. **Simplification.** Complicated formwork, complicated bending and placing of reinforcing steel, complicated steel details, unnecessary machining, and operations in restricted space add materially to costs. So also do methods of assembly or construction that require undue precision or exact measurements and fitting.

3. **Equipment.** The design should be based on making the most economical use of construction equipment. This leads, wherever feasible, to the use of large units rather than a greater number of smaller units.

4. **New Construction Materials.** New construction materials, or shop-assembled units of existing materials are constantly becoming available. For any particular project, these require evaluation as to their suitability and economy. Decided economies are possible by adopting light-weight materials and construction and other expedients which will reduce dead load.

5. **New Construction Methods and Processes.** As with materials, new methods and processes are becoming available, such as precast concrete, prestressed concrete, welding, and field bolting in place of riveting. All these have their place. They should be used where applicable and economical. In some cases practice is not as yet standardized. Considerable judgment and an analysis of all procedures is essential.

6. **Definition of Requirements.** The specifications should define, precisely and concisely, the minimum results that are required. To the greatest extent practicable, the means and methods of securing these results should be left to the ingenuity of the constructor. A high standard should be required, but precision tolerances generally are not necessary.

7. **Inspection.** The inspector stands midway between the designer and the contractor in enforcing the specifications. The most common complaints, generally justified, come from honest, experienced contractors and refer to delays and unnecessary costs resulting from enforcement, by young inspectors, of unreasonable restrictions which are not applicable to the case in point or which are not required to secure satisfactory results.

Welded railroad bridges—why not?

A number of readers have sent their comments on the article, "Are We Ready for All-Welded Railroad Bridges," by R. N. V. Brodie in the June 1952 issue of CIVIL ENGINEERING. Because of this and other evidences of interest in Mr. Brodie's article, the editors feel that further discussion of the subject will be of interest to readers. Therefore the following excerpts from discussions received are presented, together with Mr. Brodie's answer.

Welding is not a fad

TO THE EDITOR: If a railroad bridge designer is to determine objectively how a bridge shall be fabricated, he will need more complete answers to the questions posed by Mr. Brodie. These questions are not peculiar to welding; they have been asked of every joining process, by every designer, for every new structure to be built since engineering became a science. If the railroad bridge designer thinks of welding as a "technical fad," as Mr. Brodie implies, then he is shirking his duty. It indicates that he is not as informed as his fellow engineers in the highway bridge field or in building construction. What follows is an attempt to briefly fill in some of the answers.

Safety. An all-welded steel railroad bridge, designed and fabricated in accordance with the AWS Specifications for Welded Highway and Railway Bridges will be safe—no doubt about it. There has not been a single failure of any bridge built to conform to these specifications. The pioneer welded bridges and the ships mentioned by Mr. Brodie do not change the unequivocally affirmative answer. The very extensive experience with welded highway bridges and the equally wide use of welding to strengthen existing railroad bridges attest the truth of this answer.

Manner of Failure. The manner of failure of a welded joint, like the manner of failure of any other type of joint, would depend on many factors. The nature and magnitude of the load producing failure, the quality of the weld and base metal being joined, the geometry of the joint—all these and other factors are involved.

With the factor of safety used for welded bridges and with the reduced allowable stresses required for dynamic loads (covered in great detail in the AWS Bridge Specifications and appropriate for any other type of joining), the welded joint which fails suddenly will be the rare exception and such a failure would be brought on by most unusual and unforeseen circumstances. The usual engineering design does not provide for such circumstances.

Assurance of Good Welding. This point is the one most commonly raised as the reason for prohibitions against welding. Naturally the American Welding Society, its Bridge Committee, or anyone else, cannot guarantee that good welding will always be obtained. However, it is reasonable to assume that good welding will be obtained where sound regulations, as contained in the AWS Building Code and Bridge Specifications, are followed by a competent organization. An organization that has a reputation for good work should be expected to fabricate a suitable structure no matter what the joining method. Riveted designs are subject to improper fabrication by incompetent fabricators no less than welded structures; welded structures can be produced by competent fabricators to meet all intended service requirements no less than riveted structures.

There can never be any substitute for proper supervision and inspection of fabrication. These points have been further stressed in the latest edition of the AWS Building Code and Bridge Specifications. Experience has shown that practically all failures that have occurred, whatever the method of joining, could have been averted by better workmanship and by inspection to determine that the amount, kind and disposition of the joining medium (i.e., rivets, bolts, welds) were as specified in the design.

Non-Destructive Tests. While I do not believe that radiographic examination is necessary for bridge structures, there would be an educational value in its wider use for very important joints at this time. Such use, together with magnetic particle inspection, would show the bridge engineer over a period of time that he could expect good welding as a matter of course (with proper supervision and inspection as prerequisites). With more experience in this field, the bridge engineer will be willing to reduce the amount of inspection.

Where X-ray equipment is impractical for field use because of its bulk or for power reasons, gamma ray radiography can be used. To bring the cost and time within reasonable limits, a pattern of spot checking of joints in main members might be followed. This would involve extra, unnecessary cost, but it would be a worthwhile investment if it would answer some of the bridge engineers' questions.

Damage in Heat Affected Zone. The possibility of "damage in the heat affected zone" is only part of this very important consideration in the welding of bridges. In its broadest aspect it should be listed as "the proper selection of base metal." This requires an understanding of the metallurgical characteristics of the steel to be used. For thin sections, say not over 1 to $1\frac{1}{2}$ in. thick, only the carbon content may be important. For thicker sections, deoxidation and other mill practices must also be considered. This problem requires detailed comment and much has already been written on it. The AWS Bridge Committee has spent years on this subject and at present is studying specifications for a suitable steel in all thicknesses which will meet dynamic loading and atmospheric requirements and temperature requirements in different locations.

Traffic Characteristics. The railway bridge engineer more than any other engineer should have faith in the ability of a welded joint to withstand all the evils of repetition and reversal of stress, vibration, impact and lateral forces. As the railway bridge must sustain these stresses, so too must the railroad passenger and the freight car, essentially all welded structures. I think it is fair to say that the structural members of a side frame or underframe of a freight car are subjected to all the severest stresses known to structures. Then there is the rail itself, which is very commonly continuous, made of segments joined by welding. This rail is of a high-carbon steel, which imposes far greater welding problems than any steel used in a bridge structure. On the basis of laboratory tests and actual service investigations, continuous welded steel rail is a common and accepted thing.

Alteration and Maintenance. On the basis of available records I must take serious exception to Mr. Brodie's comment that riveted connections have the advantage in the strengthening of existing bridges. The New York Central Railroad has reinforced, by the addition of welded web and cover plates, a considerable portion of the elevated structure running along Park Avenue in Manhattan. The Erie Railroad reinforced one of its longest and largest viaducts by welding. These are but two examples, both reinforced under traffic, of common practice.

I have always been surprised at the reluctance of some railway bridge engineers to use welding for new construction when they willingly resort to it for the strengthening of existing bridges. In my opinion the reinforcing of existing bridges constitutes a far more critical application of welding than does any new work.

Conclusions. Specific suggestions from Mr. Brodie, or any other railway bridge engineer, as to what information would be required to give them "more assurance of security and economy" are most welcome. A considerable sum of money has been spent to determine the properties of welds under stresses of the type produced by railway and highway bridge loadings. Surely the actual service experience with highway bridges could be translated into service conditions applicable to railroad bridge loads.

It is now up to the railway bridge engineer to carefully appraise the existing information and apply it, according to engineering principles, to his own problems. If in making proper evaluation for a specific design he finds that welding does not meet his requirements on the basis of economy or for any other sound engineering reason, then he would be acting fairly in rejecting this form of joining. I believe, however, that such evaluation would encourage more new applications of welding than it would discourage.

Simon A. Greenberg
Technical Secretary
American Welding Society

New York, N.Y.

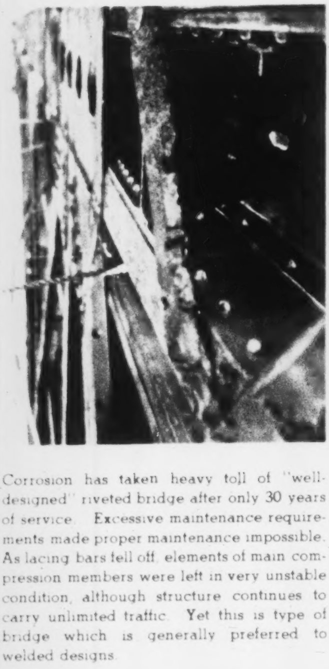
If all-welded railroad cars are safe, why not bridges?

To the Editor: My answer to Mr. Brodie's question, "Are we ready for all-welded railroad bridges?" is, "If we aren't ready for welding by now we certainly never will be."

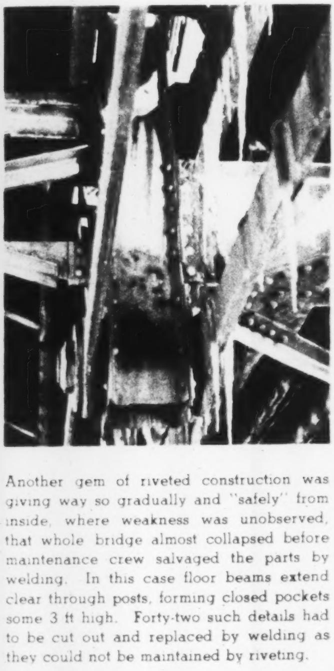
And in regard to a few of the author's other questions, the answers are that bridges will be safe, that welds will not fail if they are properly designed and executed by competent workmen, and that the bridges will be more than economical.

In the latest competition that has come to my attention in Iowa, every one of the five contractors who bid on a recent Linn County Iowa Highway Commission project, preferred an all-welded bridge as compared to a standard riveted design. In fact only two of the five bid on the riveted alternate at all, and the other three preferred the welded design by a wide margin in dollars.

I have no doubt that many very complicated all-welded structural trusses and girders are riding about on the top side of the wheels and drivers of the Boston and Maine Railroad, and are quite safely carrying heavy locomotive loads, cars and passengers over ancient riveted structures of unknown strength, being continued in service with utter disregard for fatigue and impact.



Corrosion has taken heavy toll of "well-designed" riveted bridge after only 30 years of service. Excessive maintenance requirements made proper maintenance impossible. As lacing bars fell off, elements of main compression members were left in very unstable condition, although structure continues to carry unlimited traffic. Yet this is type of bridge which is generally preferred to welded designs.



Another gem of riveted construction was giving way so gradually and "safely" from inside, where weakness was unobserved, that whole bridge almost collapsed before maintenance crew salvaged the parts by welding. In this case floor beams extend clear through posts, forming closed pockets some 3 ft high. Forty-two such details had to be cut out and replaced by welding as they could not be maintained by riveting.

Certainly then, if the rolling stock can be all welded and absorb all the reactive shocks and stresses from the entire length of the track while running hours on end, why should there be any question as to the safety of such simple structures as an all-welded deck-girder railroad bridge that is loaded for only a few minutes at a time in any particular day?

Good welds are made, either in field or shop, by properly qualified and responsible workmen. The poor welds will have been made by irresponsible and unqualified workmen or else in inaccessible locations. There is a great difference in this respect. It is far more important to determine the qualities of the welding operator than it is to devise some perfect system of inspection, designed to be applied after some unqualified person has been allowed to cast poor welds into the work for the inspector to find.

Qualify your workmen, pay them well when they have ability, and let them judge the quality of their own welds as these welds are being made. They know when the weld is right and you can devote your time and best interests to designing the work properly so that the welds will be accessible to the workman and made in proper sequence.

In my opinion we have long since been ready for all kinds of welded bridges. In fact we are a backward country in this respect, without enough know how to have confidence in our own ability to design new work.

It is easier just to sit back and cast grave doubts on the character of welding, use that same old obsolete riveted design over and over again in new locations, and shake your head sadly whenever you hear of some young eager beaver who has become so enthusiastic about welding that he doesn't know any better than to use it, when you know full well it won't save over 15 or 20 percent of the government's money or maybe even your own company's money.

NED L. ASHTON, M.ASCE
Consulting Engineer

Iowa City, Iowa

Welding processes are ready, bridge designers not ready

TO THE EDITOR: Some comments based on experience with welded structural designs and with the supervising of welded structures during their shop fabrication and erection period are offered.

First I believe that welding materials and processes are ready for all-welded railroad bridges, but the engineers who design them are not ready, because they have not been interested in welding, and consequently, although now mildly interested, have not taken the time to study the great technical strides made by welding during the past twenty years.

To engineers interested in railroad bridges, I suggest that they make a start by using welding in very simple bridge structures in the nature of rolled girders or riveted plate girders, where the entire floor system is welded. After acquaintance is developed, they can then build welded plate girders, such as those now being built in Baltimore for the Pennsylvania Railroad (see *Welding Journal*, July 1952, page 609). Next they can go to welded truss bridge construction, with the same confidence that Gilbert D. Fish, M.ASCE, had when he designed the Chicopee Falls Bridge in 1928. One does not have to start on main-line bridge work, for there are plenty of opportunities on bridges in other locations.

Too many engineers think of welding as if the weld metal were some kind of hardening putty applied to the base metal. Engineers should learn to think of welding as a lot of small increments making up the length of a given weld. They should realize that through the heat of welding, these small increments, made up of the weld material and the base material, have become intermixed into one material. They then will have a clearer conception of the strength of a welded joint and its ability to transfer load and resist vibration. A welded connection can be detailed so strong that the base material will fail first. This is well illustrated by weld tests.

As to relative economy, after designing many welded plate girders and welded trusses used in building work, I can state that they are more economical than similar riveted girders or trusses, and I see no reason to believe that welded railroad structures would not show a proportionate saving.

There are many fabricators equipped to do this kind of welded work under the most exacting shop inspection requirements. I might cite the Bailey Bridge as an example of what can be done in the way of exacting welded work. Contrary to Mr. Brodie's impression, the use of welding in shop work requires considerably less floor space than is required for riveted work. This is perhaps best illustrated by the fact that between the time of arrival of the plain steel in the shop and its shipment as fabricated material out of the shop, there are 22 steps required for riveted work, as against 6 for welded work.

Like all other costs, welding costs have advanced. So have riveting costs, but the two still remain on the same relative levels, with the advantage still with welding, to say nothing of the fact that today it is almost impossible to properly man a field job of any size with sufficient experienced riveting operators, whereas exactly the reverse is true of experienced welding operators.

The writer believes that beyond the original basic economy of welding in comparable first costs, maintenance economies will be considerable. Properly made welded joints are not subject to the rusting conditions so often found between metal pieces held together by rivets. This is well illustrated in our work in buildings subjected to chemical gases in which many riveted connections deteriorate, only to be replaced by more simple welded connections, in which there is no opportunity for the gases or other deteriorating agents to get between the connections.

The use of welding on either riveted or welded structures permits easy alteration. Welding is alteration's best friend.

The idea that damage occurs to the base material in the heat affected zone is not justified by the results obtained from samples taken in the course of our work. With proper application of weld material and proper design, welding should have no deleterious influence on the structure.

Perhaps if a railroad bridge engineer would show to someone familiar with welding details those points in a railroad bridge known to be weak in detail, he might be surprised to learn of the benefits to be derived from the simplicity of welded detail connections, which are great resisters of vibration.

In Europe before World War II many welded bridges, both railroad and highway, were in use. This situation has never obtained here, but I believe that Mr. Brodie and the other railroad engineers in this country will eventually turn to the welded bridge. In the meantime railroad engineers can get a start in welded design by keeping off of the main line until they have more confidence in themselves and have learned that a welded structure has everything to recommend it.

Van Rensselaer P. Saxe
M. ASCE, *Engineer*

Baltimore, Md.

No welded bridge failures in Connecticut

To the Editor The writer has either designed or supervised the design of some forty odd welded structures in Connecticut during the past two decades and is pleased to note that there have been no failures or even partial failures, nor have there been any cracking, warping or distortion observed in the course of continued and periodic inspection.

While a highway bridge and a railroad bridge serve essentially the same function, it is admitted that there is quite a difference in the live loads and their application. I have never made a comparison of cost between an all welded railroad bridge and one that is all riveted, and therefore cannot comment on this phase of design.

Railroad bridge engineers, like highway bridge engineers, primarily consider the matter of safety first. Of secondary importance is the matter of economics, which does not always have the same importance in the case of vehicular bridges as it does in that of railroad bridges. Frequently the demand for proper esthetic features in highway bridges may more than overbalance economic considerations. Few will argue against the statement that a welded structure presents a neater appearance than a riveted one.

John F. Willis, M. ASCE
Engineer of Bridges
and Structures
State of Connecticut

Hartford, Conn.

Past record of welded structures is good

To the Editor From a practical viewpoint, the record of welded railway and highway bridges and welded buildings speaks for itself. It is a good one, and extensive involving many countries all over the world. Although few all welded railroad bridges have been built in the United States, important main line railway bridges have been strengthened, altered and repaired by welding for many years, here and in England. This work has involved work on main members and much more difficult welding problems than those ordinarily encountered in new construction. Quite a number of all welded railway girder and truss bridges built by the French National Railways have been giving thoroughly satisfactory service for periods as long as 17 years.

It seems evident that under the abuse of humping and switching, and the impact of taking the slack out of a train of freight cars in making a start, such cars are subjected to much worse strains, reversals of stress and lateral forces than the bridges over which they travel. Under this abuse rivets work loose and parts fracture occasionally. Yet the record of welded cars, even in wrecks, is so good that welded cars, and especially welded underframes, have come into very common use in the United States.

Regarding the fear of possible sudden failure, it is interesting to note that the few failures of early welded bridges were not sudden and without warning. Eventual collapse was reported for only one structure, a long-span Vierendeel truss bridge in Belgium. For this bridge as well as those in Germany, a then existing type of basic Bessemer steel was used, peculiar to Continental Europe and its ores and steel making practices. It has now been revised to make it more suitable for bridge construction.

In recent years a number of large structural steel erection firms have changed to welding whenever it is permitted. This trend started because of a shortage of field riveters, but welding has been found to cost less.

From the cost angle, weight saving per unit is the significant factor. Total volume of steel saved in any one field would be of significance mainly from the viewpoint of conservation of strategic material. As Mr. Brodie points out, the total volume in new railroad bridge construction is comparatively small. However, it is the better economy of welding that has prompted railroads to use it so extensively in bridge repairs and alterations.

The saving in weight results from a more efficient utilization of steel material not by increased stresses as might be inferred from Mr. Brodie's remarks about "highly stressed light weight structures." The merit of using a low-alloy high-strength steel is not peculiarly associated with welding under present practices.

The significance of limiting carbon content goes much further than merely assuring weldability. In its broad sense, it does not seem to be so much a compromise between strength and weldability, as Mr. Brodie puts it, but rather a compromise between test-coupon strength and true ductility or toughness. Designing engineers are inclined to rate a material solely on the basis of the results of a standard tensile test of a small coupon, which at the best is a rough indication of the true physical properties.

The most controversial matter today, relating to large welded structures, is the proper specification for the steel material, in ranges of greater thicknesses that are seldom if ever encountered in riveted bridge construction. For best economy, greater single thicknesses are used for welded designs, for example in the flanges of heavy girders. Since the thicker material cools more slowly in the steel mill, more hardening elements, such as carbon, must be added to meet the minimum imposed requirements for yield-point strength. When carbon is used for this purpose it decreases the notch-toughness of the steel in general, as well as requiring rather expensive additional operations such as preheating when the carbon is quite high or the temperature relatively low, especially if welding is used in fabricating the material.

The American Welding Society's bridge specifications committee has now developed (for the next edition of its specifications) what appears to be an acceptable practical specification for steel material for bridges. It insures a much lower carbon content than that which has been furnished sometimes in very thick material supplied to meet the ASTM-A7 specification. The extra cost of the material, in these greater thicknesses, is more than offset by savings in costs of fabricating and welding. A better, tougher steel results, providing more reserve ductility after forming, bending, welding and other fabricating operations, to meet the comparatively severe service requirements of a railroad bridge, of which Mr. Brodie speaks.

To deny that there are still some limitations to the proper economical use of welded construction for large railroad bridges would be unreasonable, but welding can be used safely and economically for many railroad bridges, just as it has found very extensive suitable applications in the fields of highway bridge and building construction.

LaMotte Grover, M. ASCE
Air Reduction Sales Co.

New York, N.Y.

Author replies to discussers

To the Editor: The writer is gratified to receive such comprehensive and informative criticism from evidently qualified commentators.

The article in question, while inevitably containing some of the writer's own views, was intended to reflect the prevailing trend of opinion of a majority of railway bridge engineers, as indicated by them over an extended period of discussion and investigation. If their attitude is thought unduly conservative, welding enthusiasts have here a large field for propagation of their doctrines.

Let it be understood, however, that with few exceptions, railway bridge engineers, including the writer, view the subject with a background of about 25 years' experience of welded repairs and strengthening of bridges, and fabrication of many miscellaneous structures. They are in general fully aware of the merits and potentialities of welding, as well as of its disadvantages. The writer regrets that the article produced an opposite impression on some readers, such as Van R. P. Saxe, M. ASCE. Many of his suggestions, such as rolled beams with welded details, and all-welded floor systems, have been in use on many railroads for some years. Mr. Saxe's views as to fabricating-shop problems are not supported by some of the larger fabricators.

The extent of the comment made by S. A. Greenberg (American Welding Society) rather illustrates the complexity of the problems involved. Steps now being taken by his society in the direction of base metal requirements seem to be dictated by the need for more conservative practice, as disclosed by accumulated experience. The action suggested in Mr. Greenberg's closing paragraph is being actively pursued by many railway engineers and particularly by a subcommittee of the AREA, of which the writer is chairman.

The persistent comparison of highway bridges with railway bridges, as evidenced in the comments made by N. L. Ashton, M. ASCE, has not escaped the attention of railway engineers, and in general they believe that these structures are problems of widely differing nature and magnitude. It may be noted here that neither the AASHO Specifications nor the Bureau of Public Roads are yet prepared to endorse all-welded highway bridges unconditionally.

Mr. Ashton is misinformed if he believes that heavy train loads are being carried "over ancient riveted structures of unknown strength, . . . with utter disregard for fatigue and impact." A strong regard for fatigue and impact is one of the major elements in the conservative attitude of railway engineers toward all-welded or any other type of bridges. Mr. Ashton is right in emphasizing the qualifying of welders, though few engineers would go so far as to rely entirely on the welder to judge the quality of welds.

As to maintenance, welded structures are no more proof against neglect than others, and accessibility of details is a required feature of any exposed structure, riveted or otherwise.

Economic advantages can only be determined by quotations on contemporary alternatives, not by comparison with out-of-date and perhaps poorly designed examples.

Several years ago the writer inspected some of the bridges described by J. F. Willis, M. ASCE, and was favorably impressed by their performance under highway loadings. Economic considerations, however, today more than ever, dictate railroad policies, and there are strong indications that properly designed welded railway bridges would cost more than riveted spans for the same purpose. This is a question which is soon to be tested by AREA research committees.

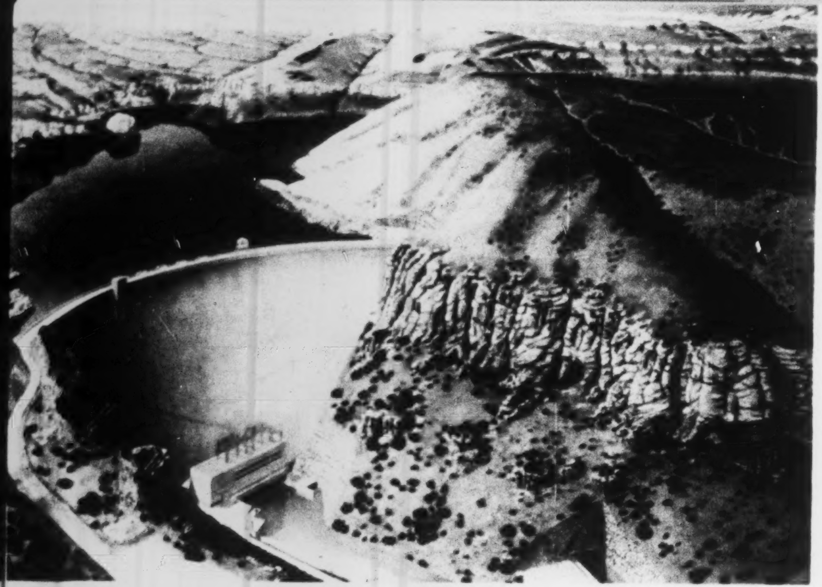
The writer is pleased to see the prominence accorded base metal composition by LaMotte Grover, M. ASCE, in his comment. This is a feature which is receiving close attention from those engaged in revising or preparing welded bridge specifications, including those under consideration by the AREA.

The writer wishes to acknowledge with thanks a number of favorable responses received from some readers who find themselves in agreement with the major premises of the article.

To those who have indicated opposite or divergent views, the writer extends assurance that the subject is far from closed, and that the railroad industry will continue to explore the possibilities of welded bridges, as it does all other fields of research of potential value.

R. N. V. Brodie, M. ASCE
Engineer of Structures
Boston and Maine Railroad

Boston, Mass.



Photoelastic studies were carried out in connection with design of Yellowtail Dam, in Montana, concrete gravity structure here shown in artist's rendering.

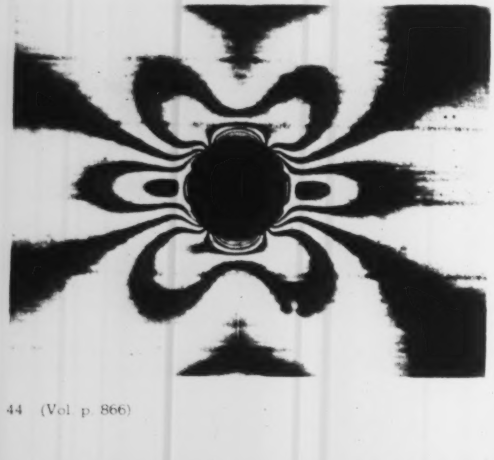
FIG. 1. Basis for model studies was taken to be typical concrete block from Yellowtail Dam and Power Plant in which steel-pipe penstock would be embedded. Dimensions of prototype are indicated. Plastic model was made to scale of 1 in. = 50 ft.

Photoelastic stress analysis solves penstock reinforcement problem

H. J. KAHM, Engineer

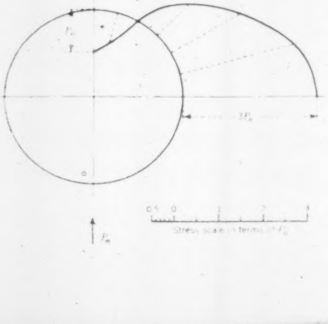
U.S. Bureau of Reclamation, Denver, Colo.

Employment of three-dimensional photoelastic techniques in studies recently completed in the Bureau of Reclamation's photoelastic laboratories in Denver has made possible an empirical solution to the problem of determining the distribution of boundary stresses around a sloping penstock embedded in a concrete



Photoelastic studies of model of section of Yellowtail Dam and Power Plant verified assumption that stress field around embedded sloping penstock can be treated as two-dimensional problem using stress normal to penstock axis. Isochromatic fringe pattern was "frozen" into plastic model before slice normal to penstock opening was removed.

FIG. 2. Stress distribution around penstock opening is drawn for one quadrant only, as distribution is symmetrical about both vertical and horizontal center-lines.



gravity or arch dam. These studies are significant in that they verify the concept that the stress field around a penstock can be treated as a two-dimensional problem and that it can be analyzed by the conventional analytical methods of determining stresses around a circular hole in an infinite plate.

These photoelastic studies were undertaken in conjunction with the design of Yellowtail Dam, a concrete gravity structure proposed for construction on the Bureau of Reclamation's Missouri River Basin Project in Montana. The slope and dimensions of the penstock, and a typical block in which the steel pipe is embedded, which formed the basis of the model studies, are shown in Fig. 1. The plastic model used in the photoelastic studies was made to the scale of 1 in. = 50 ft. The model material was a plastic of the styrene-alkyd class of resins, especially developed commercially for three-dimensional photoelastic work.

Test Procedure

The test procedure consisted of placing the loaded plastic model in an oven and raising the temperature slowly to the critical value, holding it there for a short time, and then slowly lowering it again to room temperature. The isochromatic fringe pattern was fixed in the model material by this means, so that it remained after the load had been removed, and was said to be "frozen." The critical temperature for the plastic used was 71 deg C. This temperature was determined experimentally. For an explanation of the diphase action which takes place at the critical temperature, see *Photoelasticity*, Vol. I, by M. M. Frocht, page 339.

After the fringe pattern had been frozen, a slice was removed from the model at a point halfway between the ends and normal to the axis of the opening. The isochromatic fringe pattern, as observed in a photoelastic polariscope, is seen in a photograph.

The stress distribution is shown in Fig. 2. Here it is seen that the maximum tensile stress occurs at the top and bottom of the opening, and the maximum compressive stress at the sides. For a vertical stress field, P, of 1 psi, the magnitude of these maximum stresses is

Maximum tensile stress = 0.280 psi
Maximum compressive stress = 0.840 psi

The ratio of the maximum compressive stress to the maximum tensile stress is 3:1. The analytical solution for stresses around a circular hole in an infinite plate gives the same ratio for these stresses.

Based on the equations for the rotation of stress at a point, the normal component P_n, in psi, of the vertical stress, P, equals

$$P \cos^2 59 \text{ deg, or } 0.265\ P$$

where the angle of 59 deg is the inclination of the axis of the penstock from the horizontal.

Since the maximum tensile stress was found experimentally to be 0.280 psi, and the normal stress component, P_n, is equal to 0.265 psi, the magnitude of the maximum tensile stress that occurs at the top of the opening can be found from the expression,

$$\frac{0.280}{0.265} P \cos^2 \theta = 1.057\ P \cos^2 \theta$$

where P = vertical stress field in psi
θ = inclination from horizontal of axis of penstock

This equation can also be expressed as

$$\text{Maximum tensile stress} = 1.057\ P_n$$

or practically,

$$\text{Maximum tensile stress} = 1.0\ P_n$$

Thus the boundary stresses around a sloping penstock can be determined from the usual two-dimensional analysis for stresses around a circular opening, provided that the stress field normal to the penstock axis, and not the vertical stress field, is used.

For the design of Yellowtail Dam this photoelastic verification of the analytical method is particularly significant. In this dam the penstocks closely parallel the downstream face for a considerable distance. If the vertical stress field rather than the normal stress field had been considered in the design, the amount of steel required to reinforce the periphery of the long penstock would have been much greater.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

In the early days of railroading, there were instances in which track laid with closely butting rail ends during the winter months, got badly out of alignment during the ensuing summer under the compressive stress induced by thermal expansion. Within the last few years, experimental stretches of welded rail a mile or more in length, with no provision whatever for thermal expansion, have been laid and operated successfully. If, formerly, it was necessary to leave a gap for expansion between adjacent rail ends, why shouldn't it be necessary to do so now? For solution, see page 100.

EDITOR'S NOTE: This is the seventh installment of a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April issue an article, "The Unexpected in Engineering—The Bugs," explains the project and enlarges upon the central theme that the problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef, sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that in its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it?—H. J. G.

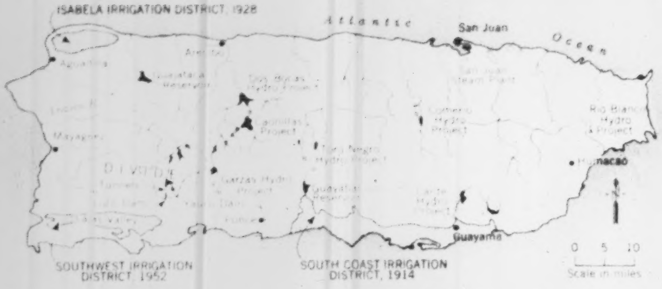
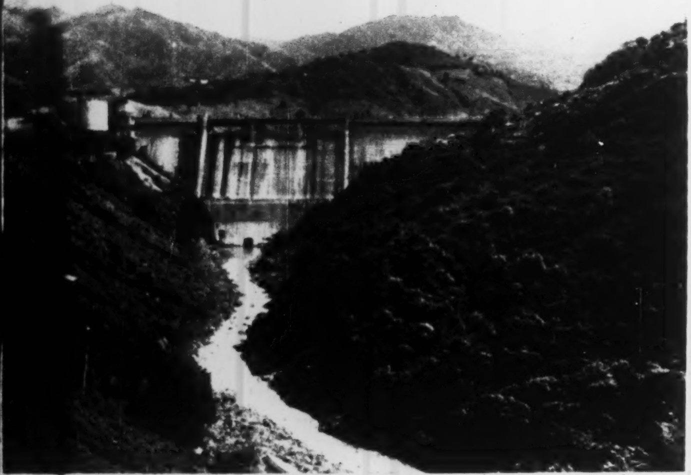
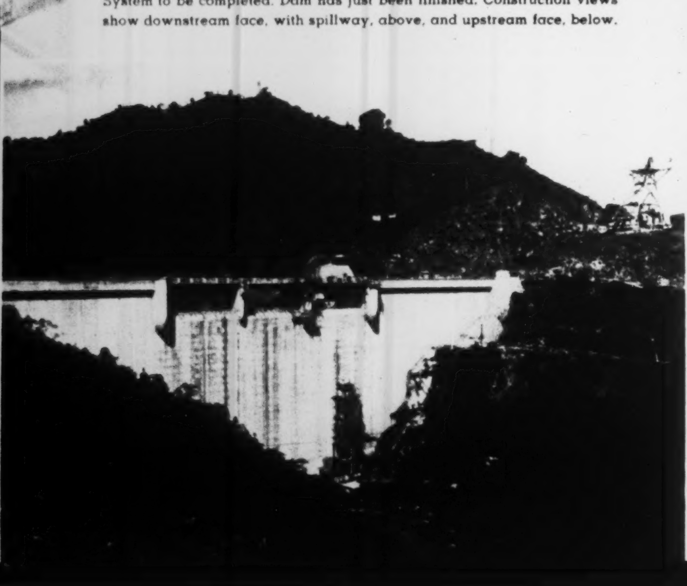

ISABELA IRRIGATION DISTRICT, 1928
Atlantic
San Juan
Ocean
Arecibo
Aguadilla
Guajataca Reservoir
Dos Bocas Hydro Project
San Juan Steam Plant
Caonillas Project
Comerio Hydro Project
Rio Blanco Hydro Project
Mayaguez
Toro Negro Hydro Project
Humacao
Divide
Garzas Hydro Project
Guayabal Reservoir
Carite Hydro Project
Yauco Dam
Lajas Valley
Ponce
Guayama
0 5 10
Scale in miles
SOUTHWEST IRRIGATION DISTRICT, 1952
SOUTH COAST IRRIGATION DISTRICT, 1914

FIG. 1. Three main public irrigation **systems** in Puerto Rico are South Coast System, built 1910-1914; **Isabela Irrigation Service, started** about 1928, and **new Southwestern System, now under construction.**



Yauco Dam is first of five dams in Puerto Rico's Southwestern Irrigation System to be completed. Dam has just been finished. Construction views show downstream face, with spillway, above, and upstream face, below.



Puerto Rico

Puerto Rico's new Southwestern Irrigation Project, now under construction, is a multipurpose project including, in addition to irrigation, provisions for water supply, power expansion, and flood control. Studies have shown that its economic advantages will extend far beyond local limits. Besides raising the standard of living of people in the project area, it will create a more favorable balance in the island's general economic situation.

For an understanding of the irrigation situation in Puerto Rico it is necessary to know a few facts about the island's location and climate and the history of irrigation efforts there.

Unbalanced Distribution of Rainfall

Puerto Rico lies well within the Torrid Zone (18 deg north latitude). Surrounded by tropical seas, it enjoys abundant rainfall in the interior mountainous region which gives rise to numerous streams. The average annual rainfall varies greatly in different parts of the island, ranging from about 30 in. a year on the dry south coast to more than 100 in. in the central mountainous areas, and over 200 in. in the El Yunque area in the northeast. This wide variation is mainly due to the topographic relief and the prevailing winds. The high mountains of the interior form a more or less continuous divide in an east-west direction. When the moisture-laden northeasterly trade winds strike this barrier and are deflected upward to cooler zones, the moisture condenses and falls as rain, largely on the northeasterly and easterly slopes. As the winds carry across the divide, the warmer air on the southern slopes tends to hold the remaining moisture, so that there is less rain along the south coastal plain. Similarly the north coast, lying almost at ocean level, receives less rain than the mountain areas, this condition applying particularly to the plains on the island's northwest corner.

The unbalanced distribution of rainfall has placed marked limitations on the development of agriculture, Puerto Rico's principal industry. The inadequacy of the water supply for crop production has long been ap-

constructs new irrigation project

ANTONIO LUCCHETTI, M. ASCE, Executive Director, Puerto Rico Water Resources Authority, San Juan, Puerto Rico

parent on the south coast, where the flat, fertile lands are particularly well adapted for growing sugar cane. This crop can profitably use about three times as much water as is supplied by the rainfall in this area. This deficiency is aggravated by the uneven seasonal distribution of the rainfall, the period from the first of December to the end of April being regularly very dry. The growing of cane requires a fairly uniform water supply

Sugar cane for many years has been Puerto Rico's most important agricultural product and early attempts to grow it on the south coast gave rise to the practice of irrigation. At first, simple stream diversions supplied water by gravity flow to small individual areas, with some pumping from surface waters and from wells. Water concessions from the Spanish Crown for irrigation purposes date as far back as a hundred years, and some of these rights are still in use. The large-scale production of cane, however, soon demonstrated the inefficiency of small isolated irrigation systems, and gave rise to cooperative action for the construction of impounding reservoirs to insure a better utilization of the water available and an adequate supply during the dry seasons.

Need for Government Action

Government participation in this undertaking was dictated by several considerations. It was clearly beyond the capacity of individual landowners to organize the large areas involved into single cooperative enterprises, or to finance such costly undertakings under existing laws. The inherent proprietorship of the government in the waters to be used, and its corresponding responsibility for determining what uses were appropriate and beneficial, emphasized the need for government action. Such action was initiated in 1908 by the passage, by the insular legislature, of the Public Irrigation Law, and of subsequent amendatory and supplemental laws. These laws incorporated large areas into cooperative districts and made possible the financing of storage reservoirs and the necessary canals and control works.

The irrigation system initiated under this law was started in 1910 and completed in 1914. The development comprised three different sources: the Patillas River, the Carite River, and the Guayabal-Coamo rivers. In general, these sources function independently, using separate canals and irrigating separate sections within the district. The total acreage now under irrigation in the entire project amounts to about 51,000 acres, of which 33,000 acres receive water by gravity and 18,000 acres are irrigated from deep wells operated by electric pumps served from the hydroelectric system.

The development of this system was financed partly by the landowners and partly by the insular government. It is also subsidized by power revenues resulting from the development of two small hydroelectric plants utilizing the head available between the watershed area and the lands irrigated.

A second public irrigation system, known as the Isabela Irrigation Service, was started around the year 1928 on the northwest corner of the island to irrigate some 8,300 acres of land. This system was also financed by the insular government and is to a great extent subsidized by power revenues resulting from the development of hydroelectric power.

There are also many small privately owned irrigation works scattered throughout the coastal lands utilizing either pump or gravity irrigation or both. Water supply for irrigation in Puerto Rico is used almost exclusively on sugar cane production.

New Irrigation Project Is Now Under Construction

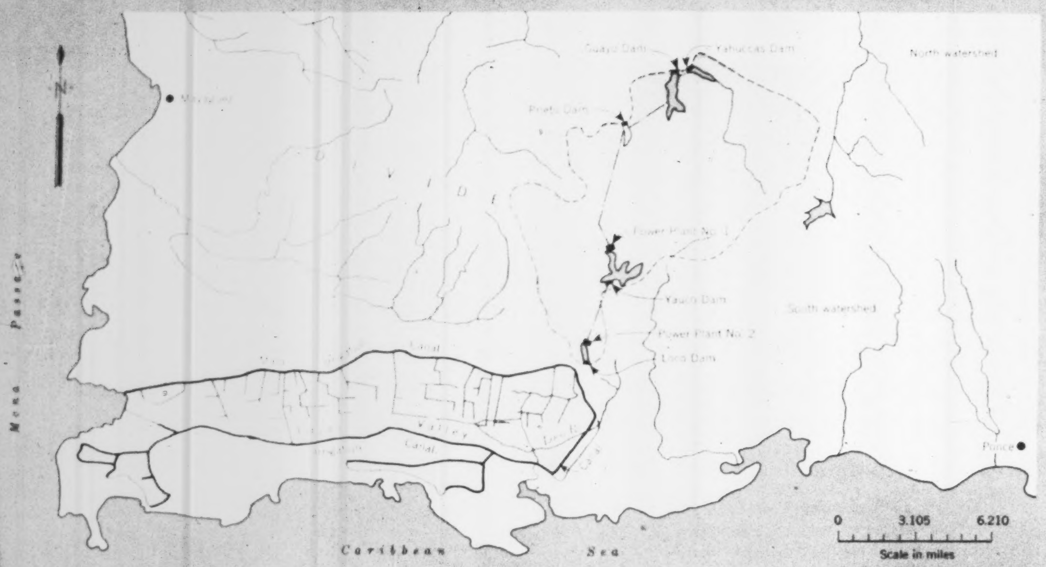
The Southwestern Project, now under construction, is a multiple-purpose project which proposes a complete development for: (1) the reclamation and utilization of 26,000 acres of good agricultural land in the southwestern part of the island; (2) development of 100 million kwhr per year of hydroelectric energy; (3) development of a potable water supply for the towns of southwestern Puerto Rico; and (4) a measure of protection from floods in the Yauco, Añasco, and Susúa river basins.

The problem of irrigation of the Lajas Valley had confronted agriculturists and engineers for many years. While the plans considered up to this point were not promising from the economic standpoint, the information developed by the various studies encouraged further investigations of the possibility of reclaiming this important area. Realizing the immediate need for expanding the productive areas in Puerto Rico the Insular Legislature appropriated the sum of $500,000 in 1945 for planning and developing new projects for irrigation. From the outset the studies pointed to the need for a bolder approach to the problem in order to fully develop the water resources of the southwestern area. Therefore, instead of attempting to limit the scope of the project in order to limit the cost, studies were directed towards obtaining an adequate supply of water from beyond the mountains to reclaim all the arable lands in the Lajas Valley.

The results of this study were encouraging. The plan proved costly, as expected, but it will provide three times as much water and twelve times as much hydroelectric power as the best previous plan. The benefits resulting from this multiple-purpose development are so great and widespread as to leave no doubt of the economic feasibility of the project. This project is not merely a matter of local power and agricultural development but also presents a means of creating new living space, new industry and new commerce; of rehabilitating, adding to, and conserving agricultural lands of great value; of providing employment to additional thousands of workmen; of raising the standard of living of the people thoughout the area; and of creating a more favorable balance in the general economic situation on the island

The Project Plan

The project extends over an area of about 250 sq miles. The waters contributing to the project will be derived from 69.3 sq miles of drainage area, of which 39.6 sq miles are on the north side of the main insular divide, where rainfall is abundant. These northern



waters will be diverted through the divide by 43,400 lin ft of tunnels at an elevation sufficiently high to develop a gross power head of 900 ft before entering a storage reservoir on the Yauco River. From this reservoir the flow, together with the runoff from the watersheds of the Upper Yauco and Duey rivers, will be diverted through a pressure tunnel having a total length of 15,300 ft, to a second power plant. The total water yield, supplemented by the runoff from 8 sq miles of the Rio Loco watershed, will then be distributed by gravity to the Lajas Valley for irrigation and water supply.

This plan involves the following:

1. Construction of five dams, ranging in height from 60 to 200 ft.

2. Driving of about 60,000 lin ft of tunnels, ranging in size from 8 to 11 ft in diameter.

3. Laying of 4,300 ft of pressure pipelines.

4. Construction of two hydroelectric power generating plants.

5. Development of an irrigation system consisting of 25 miles of main canal and pipelines, plus lesser canals and pipelines for distribution, and various appurtenant structures.

6. Installation of three small pumping stations for reusing the returned irrigation water.

7. Construction of a drainage system including 49 miles of main canals and many miles of literal drainage ditches.

The water source is estimated to supply 188 cfs for irrigation in the average water year. It will furnish 131 cfs and 175 cfs at Power Plants Nos. 1 and 2, respectively, to produce annually a normal output of approximately 100 million kwhr. In the critical year the production is estimated at 45 million kwhr for the upper plant and 22 million kwhr for the lower plant. The required power installations are 20,000 kw in the upper (No. 1) plant, and 8,000 kw in the lower (No. 2) plant.

To Irrigate 26,000 Acres

The irrigation flow, after deducting 12 percent for conveyance losses, and assuming the duty of water at 5 acre-ft (net) per acre per year, is estimated to be sufficient for the irrigation of 24,000 acres. An additional 2,000 acres will be supplied with irrigation water by pumping the return seepage. An allotment of 6.5 mgd for domestic and municipal supply represents 10 cfs, or 7,250 acre-ft per year. In addition, an allotment of an average flow of 8 cfs is made from the Yauco Reservoir to satisfy water concessions on the Yauco River.

Reclamation studies of the soils in the Lajas Valley and adjacent south coastal areas indicate that there are 39,000 acres of arable lands, which if reclaimed are estimated to have a productive capacity of from 40 to 60 tons of sugar cane per acre annually. The net area for the formation of an irrigation district is conservatively estimated at 26,000 acres, which will add about 30 percent more area to the present irrigated lands in Puerto Rico.

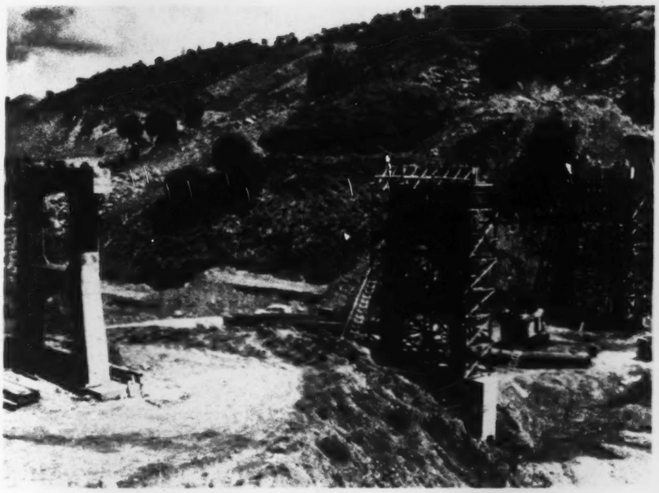
Reclamation requirements include a water supply for irrigation of the total area, drainage facilities for about 15,500 acres, and leaching the soils to reduce the salinity content on about 10,500 acres, of which about 5,000 acres will require the application of chemicals. Preliminary investigations indicate that the duty of water for optimum production of sugar cane on these lands may vary from 3 to 8 acre-ft per acre per year, with an average over the entire area of 5 acre-ft.

The lands to be reclaimed are held by a total of about 150 owners, whose holdings vary from a few acres to large estates of several hundred acres. There are 136 owners of holdings less than 500 acres, which comprise about 35 percent of the irrigable area. One property of about 2,000 acres is

Drilling progresses on one of tunnels required for Southwestern Irrigation Project. See map, Fig. 2. Tunnels have total length of 60,000 ft and vary in diameter from 8 to 11 ft.

←

FIG. 2. Southwestern Irrigation System provides also for hydroelectric power generation and domestic water supply. When completed it will consist of five dams and reservoirs, two hydroelectric power plants, and about 60,000 lin ft of tunnels in the storage system. It is estimated that 24,000 acres can be irrigated directly and 2,000 additional acres by pumping return seepage.



Piers for continuous I-beam highway bridge over arm of Yauco Reservoir are seen under construction. This bridge materially shortens length of highway relocation required by this reservoir to a little over 2½ miles. Bridge is 460 ft long and 70 ft high above lowest ground level.

held and operated by the Puerto Rico Land Authority.

Present Status of Project

The status of the Southwestern Irrigation Project as of October 1, 1952, is as follows. Yauco Dam is complete. The tunnel from Yauco Reservoir to the Rio Loco Reservoir has also been completed and the lower section is being lined with steel and concrete. Construction of the Rio Loco Dam is under way. Excavation of the foundation was started in July 1952.

Construction of the first section of irrigation canals in the system is just getting under way. This section comprises about one third of the whole irrigation system and is scheduled for completion by the end of 1953.

About 25,000 ft of the Guayo-Prieto-Yauco tunnel has been driven—about 70 percent of the total length of this tunnel, which will be about 36,000 ft. Tunnel operations are being continued at three headings—two end headings and one intermediate heading accessible through a construction adit.

The three dams on the north side of the divide will be started in the early part of 1953 and are scheduled for completion by June 1955. Preparatory work for the construction of Guayo Dam, the largest of these, is now in progress.

Construction of Power Plant No. 2, on the Rio Loco Reservoir, is now in progress, and the plant is scheduled for completion by the end of 1953. The two hydroelectric turbines were ordered in July 1951 from James Leffel & Co. They will be vertical-shaft, Francis-type turbines rated at 6,750 hp at a 310-ft net head. The order for the generators was placed with Westinghouse Electric International Co., in May 1951. These are of the vertical-shaft indoor type, rated at 5,000 kva at 4,160 volts, 0.8 power factor, 60 cycles, and 60 deg C temperature rise.

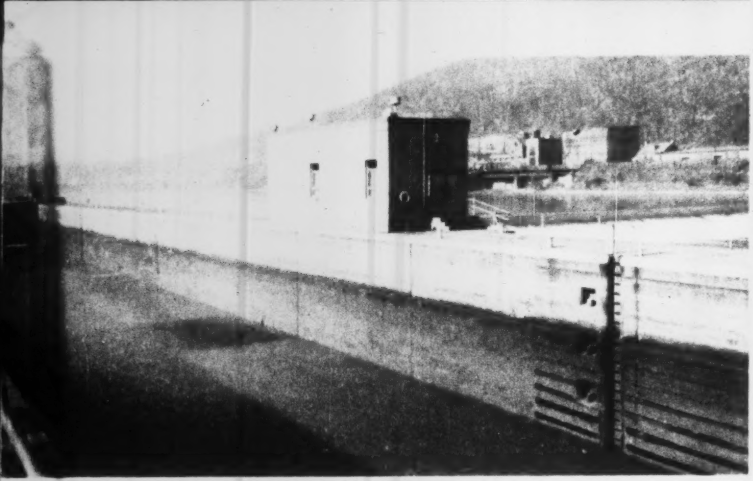
The order for the main generating and control equipment for Power Plant No. 1 was placed in July 1952 with the Westinghouse Electric International Co. It covers one Pelton vertical multi-jet impulse-type hydraulic turbine rated at 32,000 hp at a 740-ft net head; one vertical-shaft indoor-type generator rated at 25,000 kva at 13,800 volts, 0.8 power factor, 60 cycles, 60 deg temperature rise; and a power transformer, governor and auxiliary hydraulic and electric equipment.

A contract was let on August 21, 1952, for the construction of the first section of the irrigation system. The contractor is the Southern Construction Corp., a local construction firm. Actual construction of the canal system started toward the end of September and according to the contract the work is to be completed in 460 calendar days. The rest of the canal system is in the design stage. It is expected that a second contract will be let early in 1953 and that the third and last part will be contracted early in 1954.

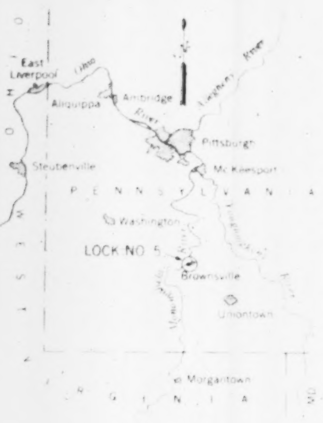
The design work on the whole project and the construction work on dams, tunnels, surge shafts, penstocks, and powerhouses is being performed by the forces of the Puerto Rico Water Resources Authority. Road location work and construction of the irrigation canal system is being performed by contract.

Financing the Project

The cost of the project is estimated at $27,000,000. The widespread benefits flowing from the development of some 26,000 acres of rich agricultural lands will greatly exceed the cost. The power feature alone will finance a substantial portion of the project. The irrigation feature will be financed by government bonds issued for the irrigation project as in the case of other irrigation districts in Puerto Rico.



When deteriorating concrete on face of Monongahela River Lock No. 5 required refacing, Corps of Engineers specifications called for concrete to be placed by either conventional or grout-intrusion method. Low bid of $85,000 for grout-intrusion method, was almost $60,000 lower than second lowest bid. Upper view shows lock before refacing, lower view, after



Lock No. 5, refaced by

Recent experience at Monongahela River Lock No. 5 has demonstrated that the prepacked-aggregate, mortar-intrusion method affords a practical alternative to conventional methods for the refacing of lock walls. This lock is located at Brownsville, Pa., 56.5 miles above the mouth of the Monongahela at Pittsburgh (Fig. 1).

The lock has twin chambers, each 56 ft wide by 360 ft long (Fig. 2). A lift of 12.39 ft is obtained between the upper and lower normal pool elevations of 749.89 and 737.5 ft above sea level respectively. Constructed

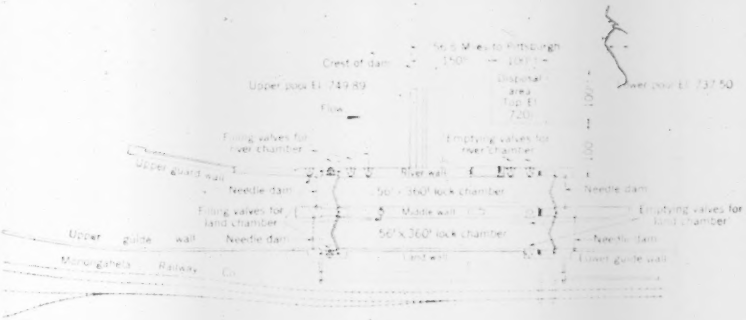
TABLE I. Unit Price Bids on Six Items Pertinent to Wall Refacing

			Bid No. 1*		Bid No. 2		Bid No. 3		Bid No. 4	
Item No.	Description	Estimated Quantity	Unit Price	Est. Total	Unit Price	Est. Total	Unit Price	Est. Total	Unit Price	Est. Total
1	Removal of existing concrete	590 cu yd	$25.00	$14,750.00	$52.70	$ 31,093.00	$ 80.00	$ 47,200.00	$130.00	$ 76,700.00
6	Concrete, new	590 cu yd	46.70	27,553.00	90.50	53,395.00	110.00	64,900.00	155.00	91,450.00
7	Furnishing cement	815 bbl	4.95	4,043.25	4.50	3,667.50	4.50	3,667.50	4.00	3,260.00
8	Furnishing and installing wedge anchor bars	10,400 lb	0.42	4,368.00	0.70	7,280.00	0.50	5,200.00	0.80	8,320.00
9	Drilling holes in concrete	2,850 lin ft	2.00	5,700.00	2.20	6,270.00	0.50	1,425.00	2.00	5,700.00
10	Furnishing and installing reinforcing steel	13,900 lb	0.20	2,780.00	0.20	2,780.00	0.18	2,502.00	0.25	3,475.00
	Other items, 2, 3, 4, 5			25,953.20		40,611.60		23,860.80	....	59,986.00
	Totals, items 1–10 inclusive			$85,147.45		$145,097.10		$148,755.30		$248,891.00

* Intrusion Prepakt Co., Inc.

FIG. 1 (left). Lock No. 5, on Monongahela River, is 56.5 miles above mouth of river at Pittsburgh. Traffic through lock consists principally of barges carrying metallurgical coal.

FIG. 2 (right). Plan of Lock No. 5 shows general layout. Corps of Engineers permitted closing of only one lock at a time. Contractor elected to perform work without cofferdamming.



Monongahela River, grout-intrusion method

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Pittsburgh District, Corps of Engineers,
U.S. Army, Pittsburgh, Pa.

in the period 1907–1910, the locks have served a heavy traffic, principally in metallurgical coal. Normal maintenance has been provided during the years since construction.

In 1949, when the scarred lock walls again required refacing over parts of their area, the specifications prepared by the Pittsburgh District, Corps of Engineers, provided that concrete could be placed by either the conventional or the grout-intrusion method. Bids of the following estimated total amounts were received:

Bid No. 1	$ 85,147.45
Bid No. 2	145,0 7.10
Bid No. 3	148,755.30
Bid No. 4	248,891.00

The low bid was submitted by the Intrusion-Prepakt Co., Inc., of Cleveland, Ohio, and the contract was awarded to this firm by the District Engineer. The successful bidder elected to employ the grout-intrusion method.

Contract work included not only the removal of existing scarred concrete and its replacement with wire-mesh reinforced concrete but also such incidental work as the furnishing and installation of structural wall armor and new corner protection, and the removal and replacement of existing corner protection, check posts, ladder rungs, hand railing, and gate anchorages. The unit price schedule embraced ten items of work, of which the six pertinent to the wall refacing are given in Table I.

Work Performed Without Cofferdams

The contractor was required to keep one of the two chambers open to navigation at all times. The contractor elected to perform the work without constructing cofferdams, a procedure permitted by the specifications. This method necessitated the removal of existing concrete below pool elevation "in the wet," and required that the new concrete below pool elevation be placed behind watertight bulkheads to exclude pool water from the spaces to be filled with concrete.

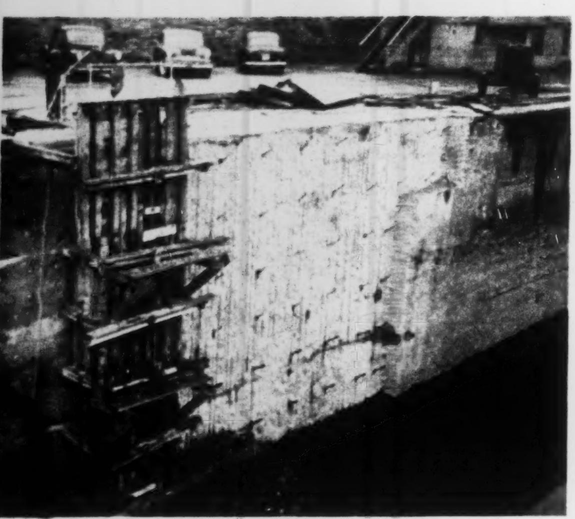
The plans called for the removal of approximately 18 in. of old concrete from an area extending from the top of the lock walls to about 18 in. below normal pool elevation and the refacing of this area with reinforced concrete.

The existing concrete was removed by line drilling the vertical face with holes spaced 6 in. on centers. Line drilling of the lower limit of the concrete to be removed was not specified, but the lower surface was required to be reasonably level. Light blasting for removal of existing concrete was permitted. Concrete removed from the lock walls was retrieved from the lock chambers and transported by barge to a designated disposal area.

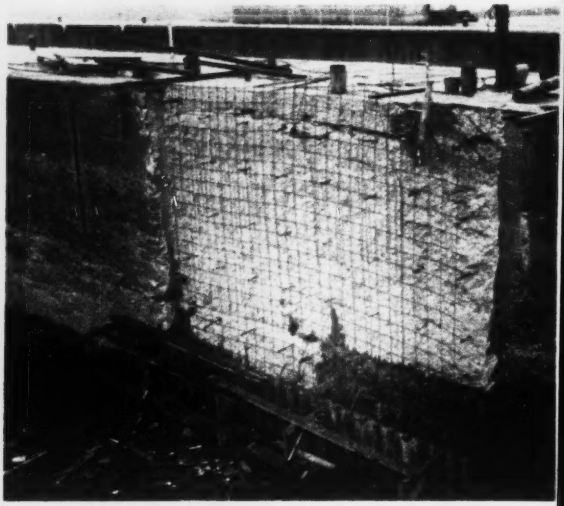
After the old concrete had been removed and the face sealed, preparations were made for placing the mesh reinforcing and constructing the forms for the new concrete. Anchor bar holes, spaced 3 ft 4 in. vertically and horizontally, were drilled to a depth of 2 ft 0 in. The holes were drilled on a slight downward slope to facilitate grouting. Wedge anchor bars were then inserted into the drilled holes and driven up on the wedges until the ends of the bars were fully expanded against the sides of the holes, Fig. 3 (*a*). A grout mixture, composed of one part portland cement and two parts fine sand, with sufficient water to produce a plastic mixture, was then rodded into the holes around the bars. The grout was allowed to set at least 72 hours before being loaded in any manner.

Anchor bars were of two types. One type, $\frac{3}{4}$ in. round, was hooked at the end and used to carry the reinforcing mesh. The mesh was spot welded to the anchor bars at a point 9 in. from the face of the form. The other type, 1 in. round and carrying a 1-in. × 6-in. hexagonal sleeve nut, was utilized to secure the forms.

Forms were built in panels of various dimensions constructed of 2-in. lagging with 4 × 4-in. studding spaced 14 in. on centers with 2 × 6-in. walers



Section of wall to be refaced has had 18 in. of surface concrete removed. Top four rows of hooked anchor bars will hold reinforcing mesh. Bottom two rows, with sleeve nuts, will hold forms.



Monolith on landward side of middle wall has been prepared for pouring by placing of reinforcing mesh.

spaced 3 ft 4 in. apart, Fig. 3 (*b*). Side wall armor was bolted to the forms before erection and anchored in the new concrete with steel straps. The take-up, necessitated by the curvature of the wall armor, was obtained by using ½-in. plywood.

When completed, the forms were filled with graded crushed limestone placed in layers, using a ¾-cu yd crawler crane. Pyramiding was avoided in order to prevent segregation and maintain proper gradation. The limestone was tamped and rodded during placing to keep voids to a minimum. It was then ready for the pumping in of the mortar.

Composition of Mortar Mix

Each mortar batch consisted of the following components: Three bags (weighing 94 lb each) of portland air-entraining cement conforming to Federal Specification SS-C-192, Type I-A; one bag (weighing 75 lb) of Alfesil, a pozzolanic material supplied by the Concrete Chemicals Co., having a specific surface of not less than 3,000 sq cm per gram, and composed essentially of compounds of silicon, alumina, and iron which combine with the lime liberated during the hydration of portland cement; 4 cu ft of sand of which from 1 to 3 percent passed the U.S. Standard No. 200 square mesh screen; 2½ lb of Intrusion Aid, also manufactured by the Concrete Chemicals Co., which imparts to the mortar properties of colloidal suspension; and 18 gal of water.

The mortar was thoroughly mixed for at least 1¼ minutes, or until a smooth slurry of about the consistency of thick cream was obtained. The mixture was kept agitated to insure its uniformity until it was pumped into the forms. The mortar was designed so that no appreciable set would occur for 1½ to 2 hours after mixing was started so as to avoid seams or horizontal joints in it due to the layer pumping procedure.

The mortar mixture was fed by gravity to a three-cylinder, air-operated pump from which it moved through three 1-in. rubber-hose lines attached to ¾-in. pipes approximately 2 ft in length which were inserted through the forms. The pipes, each provided with a valve at the connection to the hose, were placed initially 4 to 5 ft apart along a horizontal line at the lowest elevation of the space to be filled.

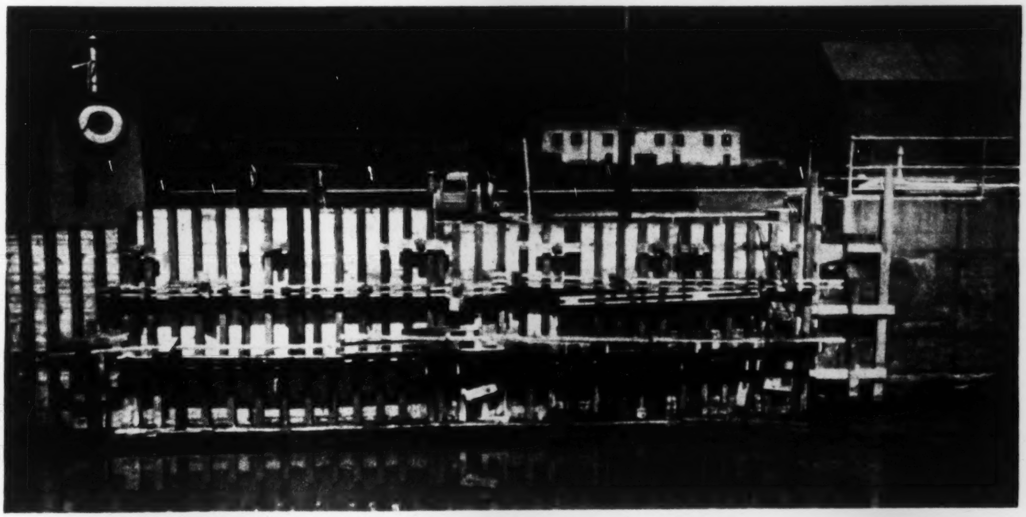
Each cylinder of the pump was equipped with a bypass which permitted closure of any of the valves leading to the hose lines in case of clogging of the lines or when the discharge pipes were moved to other locations in the form. Pumping was continued until the mortar appeared in holes provided in the form about 18 in. above the pipe centers. The pipes were then removed, the pipe entry points plugged, and the pipes raised to the next line of holes.

This operation continued until the grout appeared at the top of the form, indicating that the entire mass had been consolidated. The top surface was given a wood-float finish. Forms were left in place at least 48 hours after pumping was completed, and the concrete was cured with water for 14 days.

There were, of course, no horizontal joints within the new concrete since the refacing of each monolith was completed without interruption. Vertical joints, which coincided with the joints of the original monolith, were treated in a conventional manner by bulkheading. Expansion joints were made by installing premolded asphaltic joint filler after both surfaces of the joint had been painted with bituminous material.

Equipment used, in addition to that for mixing and pumping the mortar, included two 100-ft barges, two wagon drills, and one ¾-cu yd crawler crane. The project force averaged 55 men, working one shift the greater part of the time. All the contract work, including cleaning up, was completed in five months.

Contract specifications required



Mortar is pumped into forms which had previously been filled with graded crushed limestone. Mortar is pumped through pipes inserted through the forms. Pumping is continued until mortar appears at holes 18 in. above point of entry. Pipes are then moved up to next points of entry. This operation is continuous until mortar reaches top of form. Concrete facing is monolithic.

that concrete have a minimum compressive strength of 3,500 psi at 28 days. Steel molds were used for the forming of test cylinders. The cylinders were made by filling the molds with coarse aggregate and pumping the mortar mix into the aggregate through an insert in the base of the molds. The 6 × 12-in. test cylinders showed compressive strengths ranging from 2,880 to 4,300 psi. The average strength of seven cylinders was 3,800 psi. Results of compressive-strength tests on 6 × 12-in. cored cylinders, drilled from the refacing concrete one year later, ranged from 4,060 to 7,000 psi, the average of four cores being 5,385 psi.

The work was designed and the construction performed under the supervision of the District Engineer's Office, Corps of Engineers, U.S. Army, Pittsburgh, Pa. The District Engineer is Col. Conrad P. Hardy, M. ASCE, and the Resident Engineer was Ray P. Chester. The writer is Chief of the Construction Division.

Specified Gradation of Fine Aggregate

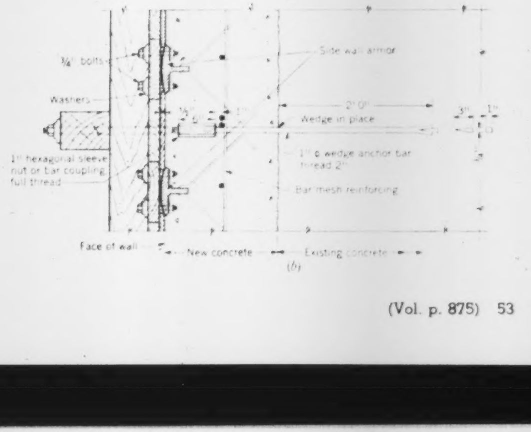
Sieve Designation U. S. Standard Square Mesh	Percent Passing by Weight
No. 16	95–100
No. 30	60–85
No. 50	20–45
No. 100	15–30
No. 200	0–5

Specified Gradation of Coarse Aggregate

Sieve Designation U. S. Standard Square Mesh	Percent Passing by Weight	
	Aggregate size No. 4 to ¾ in.	Aggregate size ¾ to 1½ in.*
1½ in.		90–100
1 in.		20–45
¾ in.	90–100	0–10
⅜ in.	30–55	0–5
No. 4	0–5	

* The maximum size of coarse aggregate used was 1½ in.

FIG. 3. Cross section shows detail of wedge anchor bar (*a*) in holding bar mesh reinforcing. Detail (*b*) shows wedge anchor bar used to anchor forms.


Varies
9'' (Except at ladder recess)
Face of wall
⅝'' φ @ 10''
2' 0''
Wedge in place
2¼''
¼''
¾'' φ wedge anchor bar
⅝'' φ @ 10''
New concrete
Existing concrete
(a)
¾'' bolts
Washers
1'' hexagonal sleeve nut or bar coupling full thread
Side wall armor
½''
6''
1''
2' 0''
Wedge in place
3''
1''
1'' φ wedge anchor bar thread 2''
Bar mesh reinforcing
Face of wall
New concrete
Existing concrete
(b)

Future development of the art and science of highway engineering

The truly fantastic magnitude of this engineering product we presently term highway transport, and the depths and ramifications of its penetration into the social and economic patterns of our national life, defy full understanding. The projection of its future outreaches the accepted methods of prophecy. Fortune telling and crystal ball gazing are not practiced by the engineering profession. It may be that, in his complete disdain of these ancient arts, the engineer hitherto has forfeited in some measure means to the leadership of public thought and public policies that he is by training and experience fitted to command. Certainly it will be accepted generally that far seeing leadership is needed now in the whole field of highway engineering in a degree far surpassing the requirements of the past.

But, in place of the illusions of the crystal ball, the experienced engineer now has proven techniques and yardsticks approaching divination power, to ascertain the factual components of a soundly charted course into the future.

The American Society of Civil Engineers, celebrating its one hundredth birthday, has the proof of engineering advances across broad fronts vividly presented by the exhibits of the Chicago Museum of Science and Industry. Pride in the proven record of accomplishment is a natural human reaction. Complacency in that pride at this period can well be the real cause of a disastrous loss of leadership. Having created his potent tools of change, the engineer cannot now fail to recognize the consequences of their use or disclaim responsibility for confining their power to constructive purposes.

In a recent issue of a Chicago paper, in a story about the convocation of engineers, appears the following sentence: "However, the old line engineers aided by the slide rule, and the blueprint boys working in anonymity, have long since proved their ability." One of the facts submitted to prove the statement is that millions of Americans can now ride coast-to-coast in three types of transport widely different in character. As a statement of fact, no one will deny its authenticity, but no engineer who knows transportation will agree that the several types of transport available have yet been integrated into systems of ultimate economic potential, or even optimum present service.

The principle here involved is of great moment, not only for highway engineers but for engineers in many other fields, since identical implications cut across many areas of our economy. The engineer, having created potent tools for change, has taken on the responsibilities of a work that will never be done. Why this is true becomes apparent upon analysis of the subject of this discussion.

Definition of Terms

Common usage does not distinguish the terms "art" and "science" along exact lines. The standard dictionaries permit a degree of interchange between them. If these terms are traced back to their Latin origins, there appears to be substantial support for more precise limitations on their use in a technical discussion, as, for example:

Art (Latin, *ars*): Skill in performance acquired by experience, study or observation, and a systematic application of knowledge or skill in effecting a desired result.

There is ample authority to limit here the use of the term to the application or practical use of acquired skills and knowledge.

Science (Latin, *scientia*): An order of systematized knowledge or a branch of study concerned with the observations and classification of facts, especially with the establishment of verifiable general laws, chiefly by induction and hypotheses.

Science, thus defined, can and does exist as an entity without any application to the solution of problems.

Objection may be made that these definitions are too narrowly limited, since there are marginal overlapping areas which have the characteristics of both art and science, but this objection does not invalidate the conclusion of the discussion; so, first, consider the current status and future promise of highway engineering science.

Science and Highway Engineering

A listing of the most important current researches, tests and observations, extends into these general fields:

Soils, including soil mechanics, soil chemistry, soil maps.

Construction materials, including asphalts, tars, stone and gravel aggregate, cement, concrete and bituminous mixes.

Structural design of roadways, including subgrades, subbases and wearing tops.

Bridge materials and design, including prestressed concrete, welded joints, continuous spans, deep foundations.

This is still an incomplete list of the physical and chemical researches only now under way by many agencies and in many laboratories. Equally important are the economic and financial studies of many phases such as: traffic flows, both qualitative and quantitative; driver behavior; traffic capacities, including the influence of design; highway finance, including benefits; surveys of highway needs; traffic forecasting in relation to anticipated economic development; highway net patterns, including highway classification into logical systems; regulation of traffic, both loads and speeds.

The laboratory facilities now available are extensive and modern—not universally as yet, but there is constant building. The research worker has been quick to make use of the most recent wonder tools of ultramicroscopy, electronics, ultra-sonics.

Through the association of research personnel in such organizations as the Highway Research Board of the Na-

THOMAS H. MacDONALD
HON. M. ASCE

Commissioner of Public Roads
Washington, D.C.

tional Research Council, a spirit of free giving and taking of new knowledge as it develops is perhaps the fullest guarantee possible of the certainty of future progress of the science of highway engineering.

Every element necessary to insure the advance of our verifiable knowledge in the broad phases of highway engineering is in operation. The scale of operations is becoming adequate, as the Maryland and the Idaho cooperative tests bear witness. The interest in research of officials, industrialists and users, is constantly focusing more closely on the same objectives.

There is the inescapable conclusion that progress in the science of highway engineering, i.e, verifiable knowledge, will go steadily forward and be constantly adequate to our needs when fully applied.

The Art of Highway Engineering

Future performance in this field is uncertain. Currently, performance is inadequate and has been in the past. It is in this field that the highway engineer must exert a more determined leadership.

Progress in the realization of an adequate and efficient highway transport for all parts of the nation will be governed by the degree to which the highway engineer and highway administrators are permitted to carry into effect the science of highway engineering included in the complete concept of highway administration. There are certain "musts" for the highway engineer or administrator himself.

The highway engineer must recognize that the field of highway engineering is now confined to the construction and maintenance of the physical structure of the highway. He must recognize more fully that his responsibility is related broadly to the development of highway transportation generally—that the purpose of highway engineering is to move people and goods quickly and safely.

The highway engineer must recognize that highway transportation is an integral part of the economy of the nation. Development of a highway transport system adequate to permit national economic and social growth requires also the determination of the proper relation between highway transportation and other forms of transportation.

There must be recognition of the need to fit highway transportation in urban areas into the changing character of those areas. It must be accepted that "decentralization" of urban areas, whether good or bad in theory, is in fact in process. The automobile is remaking the American city, and no problem in the immediate future seems to offer greater challenge than the problem of guiding the redevelopment of metropolitan areas to fit the desires of the people inspired by the new flexibility of highway transport. Proper planning of highway and integrated terminal facilities can do much toward stabilizing old, and creating new, values.

The problem of safety requires a direct and independent attack rather than treatment as a collateral adjunct or by-product of other activity. Important steps are:

1. Broader application in highway design of principles already proved.

2. Improvement in design and regulation of vehicles. Much opportunity exists for changes in physical design to reduce not only the number of accidents, but also the seriousness of their consequences.

3. Action toward greater uniformity of regulations and improvement in traffic control devices, particularly in highway signs.

How to evaluate the future of the art of highway engineering, that is, the actual application of science to secure desired results, involves these perplexing questions. How much highway improvement shall be undertaken and at what rate? Decision upon these questions does not lie directly within the authority of the highway engineer or official. It is within their discretion to become the advocates of two essential concepts. The first of these is that our highways must have a completely integrated pattern for improvement and continuous maintenance, no matter how many systems or classes may be involved, and their future administration by the several units of government must be cooperative and not competitive. The second is that this important objective will require a complete overhauling and revision of highway laws in most of the states.

Down through the years of history the highways have reflected the efficiency, even the integrity, of government. A common but mistaken belief is that the great road systems of the past were built as military highways. The fact is overlooked that these systems were built, after conquest of territory, for administration and economic development, and not primarily for military purposes.

The conclusions that emerge from this brief review of a subject of such magnitude and such diverse ramifications are: first, that we may with confidence expect the *science* of highway engineering to grow and to provide new and refined knowledge reasonably adequate to our needs; second, that practice of the *art* of highway engineering will be seriously handicapped for an indefinite period, should we fail to revise and to modernize the laws which govern highway development.

If there is any disposition to question this latter conclusion, consider one essential element of our highway administrations—the technical personnel. No matter how sufficient the science, i.e., the knowledge of how to design, construct and maintain roads, the application of this knowledge will be inept without competent technical organizations. How many of the state, city or county governments have now or are in the process of making effective laws to adjust salaries, provide reasonable retirement annuities, attract engineering graduates to enter a career service, or extend in-service training to promising employees?

The future development of the *art* of highway engineering will be a test, not of highway engineering *science*, but of government itself. The possibilities of securing for the common good the constructive and desirable services of highway transport made possible through science, and of eliminating the destructive elements, will be determined by the progress in better laws and effective organization of government. The highway engineer needs to assert leadership in securing, through a thorough modernizing of highway laws and governmental organization for highway administration, the opportunity for highway engineering *science* to mature usefully into the *art* of highway engineering.

(This article was originally presented by Mr MacDonald as an address before the Highway Luncheon, at the Centennial Convention in Chicago.)

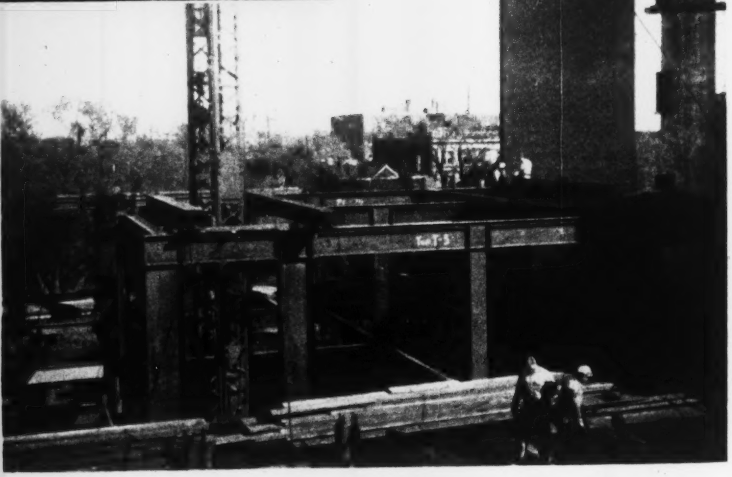
Left:

Design of gymnasium roof bents followed policy of simplicity of detail.

Below:

Physical characteristics of Vierendeel truss made it particularly adaptable to needs of Educational Institute of the Flatbush Jewish Center. Trusses span second-floor auditorium while permitting passage of third-floor corridors through them.

Completed structure, exclusive of land and interior equipment, cost about $1.17 per cu ft. Erected cost of steel was about $206 per ton.



One-story Vierendeel trusses ideally

The design and construction of the Educational Institute of the Flatbush Jewish Center, a congregational social center and parochial school in Brooklyn, N.Y., involved certain unique structural innovations in the use of three one-story-deep Vierendeel trusses. The Vierendeel trusses afforded maximum clear floor-ceiling height for the classroom floors, within New York City Building Code limitations and also, simultaneously, permitted an unobstructed school corridor to run through the north panel of each truss. The selection and utilization of these trusses, and certain features of their details, are discussed in this article.

In public buildings of this kind, structural economy often must be subordinated to the architectural, ventilation, and illumination requirements if the optimum in building value is to be obtained. Beam spacing in certain areas, omission of beams in some classroom ceilings, or other considerations frequently govern the structural design.

Architecturally, the variants in functional analysis of floor areas and connections with existing structures made it impossible to spot continuous column runs in the interior, except for the elevator and stair enclosures. Exterior façade treatment was deliberately coordinated in this case to secure continuous column runs from foundation to roof, except where setbacks occurred.

The problem in designing this building was to provide within one building adequate facilities for both

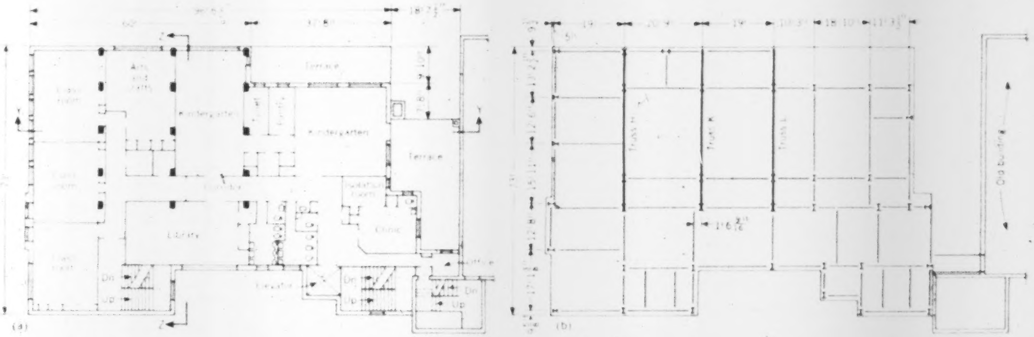

(a)
Kindergarten
Kindergarten
Terrace
Terrace
Corridor
Library
Clinic
Elevator
Office
Dn
Up
18'-7½"
(b)
Truss H
Truss K
Truss L
Old building

FIG. 1 (*a* and *b*). Floor plan of third floor (a) shows location of corridors and classrooms that dictated use of Vierendeel trusses shown in steel plan (b), which span auditorium on second floor. Trusses H, K, and L are Vierendeels.

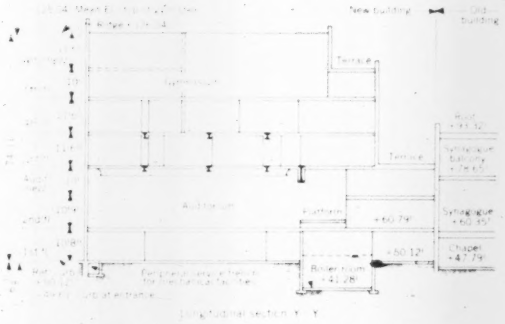

New building
Old building
Gymnasium
Terrace
Roof +93.32
Synagogue balcony +74.65
Terrace
Auditorium
Platform
+60.79'
Synagogue +60.35'
+50.12'
Chapel +47.79'
Boiler room +41.28'
Longitudinal section Y-Y

FIG. 2. Tonnage of steel required for plate-girder design would have been double that required for one-story Vierendeel trusses.

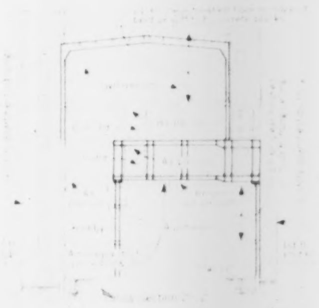


FIG. 3. Air ducts were more easily placed when Vierendeel trusses were used. Verticality of truss members also influenced choice of this type of truss.

suited to school building

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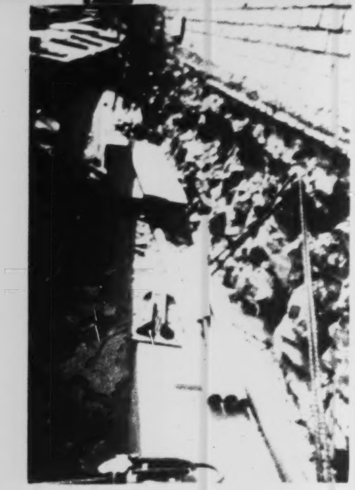
Civil and Sanitary Engineer, New York, N.Y.

adult social activities of the congregation and parochial elementary school functions. In addition, the building had to be physically connected to the existing synagogue building at certain lower levels. The building was to be erected on an interior city lot abutting on the synagogue at the rear. The lot is rectangular, 80 ft on the street and 130 ft deep and has a 30-ft setback deed restriction at the street. Other zone restrictions pertaining to land coverage compelled the design of considerable court and yard areas at the ground floor, with successive decreases of usable area commencing at the third-floor level, by setbacks at the rear and side of the building.

An analysis of school, public assembly, and social functions indicated that five full floors and two mezzanine floors would be required. Flow patterns of crowd movement (especially related to synagogue functions such as weddings and confirmations) showed the desirability of placing social, public assembly, and some administrative areas at the same level as the chapel and synagogue of the old synagogue building, and of interconnecting the areas concerned. Thus, the first two floors and one mezzanine were devoted to social and public assembly use. The upper three floors (including a gymnasium) and the other mezzanine were devoted to school use. Such an arrangement made an elevator a necessity, and the building code required the inclusion of two independent, remote, interior public stairs to the roof. The maximum height of the building



Poor condition of lot-line foundations of adjacent structure influenced decision not to excavate basement area. Engineers felt that abnormal risk was not justified by value of space gained.

exclusive of bulkheads) was restricted to [illegible] ft above curb level.

In planning the school, the gymnasium was placed on the top floor, above the two classroom floors, primarily for structural reasons. Thus the gymnasium ceiling was the roof and, in accordance with school standards, a clear height of 20 ft was sought. For classrooms a minimum height of 11 ft was desired.

A combination lecture and banquet hall was placed on the second floor, at the level of the existing synagogue, since the hall was also planned to accommodate 450 persons for certain holy day services. For architectural reasons a clear height of 18 ft was necessary. The building code directed mechanical ventilation for the hall, but this was modified by the building committee, who specified complete air conditioning. No social or administrative facilities were desired below grade.

Certain physical factors limited the use of any subgrade areas to the minimum required for mechanical facilities. These factors concerned the existing lot-line construction of two apartment houses, one to the north, the other to the south of the lot. Both are built of wall-bearing brick, with basements carried down about 4 ft below grade level, or about 2 ft below curb level (the specification for new building construction). The building on the south lot line has six stories and a basement in good condition. The building on the north lot line has four stories and a basement in poor condition. Its lot-line wall at the rear is fissured with cracks. An exploratory excavation at the lot line of this building revealed that the foundation wall consisted of rubble stone laid almost dry. Such mortar as may have been used initially was either absent or so loose that it could be easily removed. Borings revealed that the soil was an excellent grade of mixed sand and gravel over alternate layers of sand and gravel.

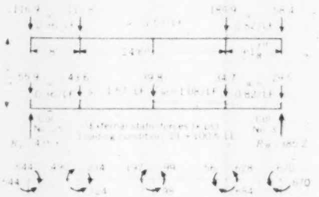
Thus, if the first floor level of the new building were to be set 6 in. above curb level and if a cellar floor were to be included, with a 10-ft clear height, continuous lot-line underpinning approximately 10 ft deep would have been required. This would have been expensive, and also the condition of the four-story building would have made the procedure abnormally risky. The gain in usable space was not considered justified in view of these circumstances. Only a deep boiler room was constructed, and in a manner not requiring underpinning. The only underpinning necessary was at the lot-line column footings contiguous with the four-story building. The specific areas involved were carefully underpinned for the full width of each individual column footing. Care was exercised during the pouring process to maintain a physical separation between the underpinning and the column footings, so that the latter might have freedom of action without affecting the apartment wall.

The floor plan of the third floor (Fig. 1, *a*) indicates the problems of selecting column locations in the interior of the building. The corresponding steel plan is shown in Fig. 1 (*b*). This consideration dictated the use of trusses rather than plate girders over the hall. The hung ceiling of the hall constitutes a return-air plenum, and includes the supply ducts. The fabrication involved in providing for the necessary openings and reinforcement in the webs of all the plate girders, as well as for the additional weight, would have made plate girders uneconomical. An actual preliminary investigation was conducted to determine the relative economies of plate-girder design over one-story-deep truss design. The tonnage required for plate girders and the corresponding fourth-floor members was more than double that required for the one-story-deep Vierendeel truss (Fig. 2).

From the viewpoint of economy, one significant item was the method of fireproofing the steel work which would come within the plenum area, in accordance with building code requirements. The relatively shallow chord sections of the Vierendeel truss made it feasible to pour concrete fireproofing integrally with the slabs, while still allowing adequate space between the soffit of the fireproof truss and the hung ceiling for the placing of air ducts and for free motion of the return air in the plenum (Fig. 3). Were plate girders to be used, all web openings utilized for duct work would have to be larger than the net duct area for duct construction and fireproofing, and fireproofing, even if of metal-lath construction with vermiculite plaster (to save weight), would have made the plate girders considerably more expensive than the trusses.

Considering the third-floor architectural plan, the Vierendeel trusses were most suitable. A school corridor which has to run through the northernmost panel of each truss must be unobstructed to accommodate an air plenum at the corridor ceiling (for the classrooms) and also to provide free corridor passage. In those classrooms with walls placed on the truss line, it was felt that a very distracting pattern would result if the walls included the diagonals of a determinate truss. Also, if the diagonals were furred, there would be a significant loss of usable classroom area whereas the Vierendeel verticals appear merely as conventional column breaks in the wall. In one set of classrooms, the verticality of the Vierendeel truss members permitted the utilization of truss width for the required student closets and wardrobes.

FIG. 4. Truss stresses were analyzed by Hardy Cross moment distribution method after initial selection of members had been made by coefficient method of T. Sakai. See Table I for analysis.



In designing the Vierendeel trusses, it was felt that maximum economies in fabrication could be effected if the truss were shop-welded, with all field connections riveted. It was also felt that a design which could be restricted to straight members, with 90-deg corner details, would retain some of the economies of the truss design.

The truss was analyzed by, first considering vertical forces on the bent (Fig. 4). The members were initially selected by the coefficient method of T. Sakai. Then the conventional moment distribution method developed by Hardy Cross, Hon. M. ASCE, was used. The first moment distribution analysis was carried to balanced joint moments, and from these moments the resulting panel shears were computed. The differences, in each panel, between the computed panel shears and the panel shears determined from external static considerations, were termed "unbalanced shears." Joint moments corresponding to these unbalanced shears were then computed and applied by a second moment distribution analysis. From the resulting balanced joint moments, the corresponding panel shears were computed, and were found to differ from the shears applied at the beginning of the second analysis. The unbalanced shears of the second analysis were applied again as external shears, and thereby a third moment distribution analysis resulted. In this fashion five moment distribution analyses were made, and in each case the unbalanced shears were determined. A tabulation of the joint moments determined at each cycle revealed an apparently converging series of successive corrections. Therefore it was possible to discontinue the moment distribution analyses after the fifth cycle and to apply the successive corrections by extrapolation. Table I indicates this procedure.

Applying the results of the tabulation, the points of inflection in all members were determined and, with this information, an analysis of each member was made. Verticals and top chord members were investigated for combined moment and compression, utilizing the method of the sum of the ratios of computed stress to allowable stress for column action and for bending, respectively. The formulas specified by the New York City Building Code were used as follows:

In column action,

$$s = 17{,}000 - 0.485\left(\frac{L}{r}\right)$$

In bending,

$s = 20{,}000$ (no wind stress included),

in which s is the stress in pounds per square inch.

The bottom flanges of the top chord were investigated considering r as the minimum radius of gyration of the section, because the concrete slab was not assumed to contribute any lateral support at that level.

Investigations were made of truss H, which is very similar to truss K, for the following conditions: Dead load plus 100 percent live load over the entire truss, dead load plus 100 percent live load over the north (corridor) half of the truss, and dead load only over the south (classroom) half of the truss—all with a superimposed wind load of 20 psf laterally.

In regard to the truss proper, it was found that dead load plus 100 percent live load controlled all design. The panel point deflections were computed on this basis, using the conjugate beam method. The relative stiffness of the truss, as contrasted with that obtainable in the economic design of determinate trusses or plate girders, may be appreciated by examining the computed panel point deflections of the bottom chord. The greatest computed deflection is 0.109 in. The maximum permissible deflection, based on $^1/_{360}$ of the span for plastered areas, is 1.39 in.

Examination showed the truss to be much stiffer than the supporting columns. A moment-resisting column joint therefore had to be used because of the required wind resistance and, in a structure of this nature, because of resistance to sidesway. Thus, under conditions of no wind load, the column would have moment induced at its top directly related to the angular rotation at the end of the bottom chord of the truss, computed for the condition of dead load plus 100 percent live load.

In analyzing for wind stresses, the assumption was made that the gymnasium bent columns would transmit the shears down to the top chord of the truss, and the column connection was made moment resisting. After the decision to use Vierendeel trusses had been made, they were designed to be shop welded, and details were prepared which would permit the maximum practical simplicity in fabrication. Accordingly, all panels were planned with square corners. Rolled sections were selected for the chord members. Top and bottom chords were run continuously, and where change of section was required, top flanges were kept level, and top flanges and webs were butt-welded, as was the inclined bottom flange transition piece.

Consideration of the required moment resistance at the panel points indicates that an angular movement of the verticals, caused by yielding of the top or bottom chord flanges or web, should be prevented. Normally, in the Vierendeel truss, the flanges of each panel are carried continuously around the panel, and the corners are fabricated with significant radii of curvature, as compared with the panel dimensions. In this case, however, web stiffeners, similar to those used in plate-girder design, were inserted between the top and bottom flanges of the horizontal chord members, thus serving the triple purpose of keeping the web true in the web plane, of preventing a warping (up or down) of the inside flange of the chords, and of

TABLE I. Moment Distribution Analysis for Truss K (Fig. 4)

	Moment in Foot Kips of Truss Member at End First Noted*							
	AB	BA	BC	CB	CD	DC	DE	ED
Cycle No.								
1	+286	+254	+127	+82	31	36	286	315
2	137	125	55	62	42	19	164	173
3	65	61	22	24	13	1	91	91
4	32	30	10	10	4	−2	45	46
5	14	12	12	11	5	2	22	23
Extrapolation No.								
1	6	5	5	5	3		11	11
2	3	2	3	3	1		5	6
3	1	1					3	3
4*							1	2
Totals	+544	+490	+234	+197	99	56	628	670

* Condition: Dead load plus 100 percent live load, reduced to equivalent panel point loads.

transferring the moment stresses of the vertical flanges to the web of the horizontal chord members. As far as the author is aware, the development and application of Vierendeel trusses are original.

Simplicity of detail was the policy in the design of the gymnasium roof bents. The knee haunch was carried down to the point where a column selected for vertical loads and sidesway would be stressed up to the stresses permitted under the building code.

As a matter of general information, certain details of construction should be mentioned. Mechanical facilities below the ground (first floor) were provided by construction of service trenches, some peripheral and others central. The two-story height of the boiler room permitted cooling facilities to be placed as a central system, with the air-handling equipment of one zone, boilers, oil burners, and associated equipment. Electric service and distribution panels were placed on one wall. Access facilities were planned to facilitate the delivery or removal of the largest pieces of equipment, exclusive of the boilers, through an access door directly to the yard.

The structural steelwork was fabricated and erected by the steel subcontractor. However, the Vierendeel trusses were fabricated by the Bethlehem Steel Co. and shipped from the shops directly to the job site by rail and trailer. No difficulties in erection of the trusses or of the gymnasium bents were experienced. At the request of the subcontractor, all riveted connections were changed to bolted. Therefore all moment-resisting connections, all column connections, and all beam connections within 5 ft of the columns, were made with Dardelet bolts and all other connections, with unfinished bolts.

Floors were planned with a minimum number of beams in certain areas such as classrooms. Since the average size of a classroom (for 20 pupils) was about 18 ft × 22 ft net, it was possible to design reasonably economical flat slabs, with peripheral beam framing arranged at the sides of the room, where practicable. To minimize dead load, two-way slabs made with Slag-Blok, as manufactured by Republic Fireproofing Co., Inc., of New York, were used. The use of 6-in. blocks (each block composed of two sections 8 × 16 in., butted to form a hollow member 6 in. high and 16 in. × 16 in. in plan) with a 4-in. concrete joist rib all around, made possible a saving of about 26 psf in floor weight, when contrasted with solid concrete floor. The procedure, generally, was to form and set the block and reinforcement, and to pour a structural floor of net thickness equal to the block height. Later, a 1½-in.-thick concrete topping was poured and floated to a hard smooth finish. On that, asphalt tile, or wood, as required, was set in mastic. The ceilings were finished with acoustic plaster.

All concrete was delivered in transit mix trucks, and samples were taken and tested regularly. The abbreviated specifications are given in Table II.

Roofs, generally, where no terraces for normal human occupancy were contemplated, were of 2¾-in.-thick precast cinder concrete plank, as manufactured by Concrete Plank Co., Inc., of New Jersey. This precast plank was found economical for quickly covering the service trenches at the ground floor, described previously. A topping was then poured and finished off with the required flooring.

The exterior walls are all curtain walls, with a backup of Natco tile and with furred plaster on metal lath inside. The facing is of two types—stone ashlar and common brick. All structural members were set back from the exterior finish line a distance of 4½ in. on the brick façades and 5 in. on the stone façades. This permitted the use of 4-in. stone ashlar with the necessary parging behind it, and, on brick façades, the use of uncut brick with mortar on the back face.

The building was erected in two stages. First the demolition, excavation, foundations, and steel skeleton were completed. The second stage began as soon as bids were accepted from general contractors. The time required for the second stage was about 14 months. The timetable was affected markedly by a city-wide strike of masonry-materials truck drivers for about one week, and subsequently by a city-wide strike of steam fitters and some welders for about twelve weeks. A complicating factor in the schedule was the necessity of building around an extension of the old synagogue building which housed the very meager administrative office until other quarters were completed. The extension was demolished after the new building had been carried above and around it.

The volume of the new building, inclusive of the areas of common connection to the old synagogue building, is about 685,000 cu ft. The total cost of the project, exclusive of land and interior equipment, such as furniture for classrooms and offices, rugs, drapes, special chandeliers, interior decoration, and cooling plant, was about $804,000. This cost includes all electric fixtures except chandeliers (the fixture schedule included being in excess of $11,000), fire-alarm system, clock and time-signal system, public-address and radio system, all air-handling equipment, and temperature-control system. Also included are fees for architectural and engineering services. Approximately 300 tons of structural steel were involved. The cost, erected, was about $206 per ton.

Maurice Courland, AIA, was the architect. The author was the engineer (for structural, mechanical, lighting, and electric design). Nehama Merle Courland was the interior designer and decorator. J. R. Stevenson Corp. was the general contractor. Grand Iron Works, Inc., was the subcontractor for all steel fabrication and erection. Barnaby Concrete Co. was the subcontractor for all concrete work, forms, setting of reinforcement and Slab-Blok, and such underpinning as was required.

TABLE II. Abbreviated Specifications for Concrete

Type of construction	28-Day Strength
Reinforced foundation walls and footings Plain footings and substructure walls	2,000 psi
Reinforced concrete beams, slabs, and joists	2,500 psi
Grade slabs, walks, drives, and slab topping	3,500 psi
	Admixtures by Master Builders Co.
Walks, drives, play yard, etc.	Pozzolith No. 5-A
All interior topping on slabs	Pozzolith No. 5
Base plate grout*	Embeco

* Mixture of portland cement, coarse sand, and Embeco in 1:1:3 ratio.

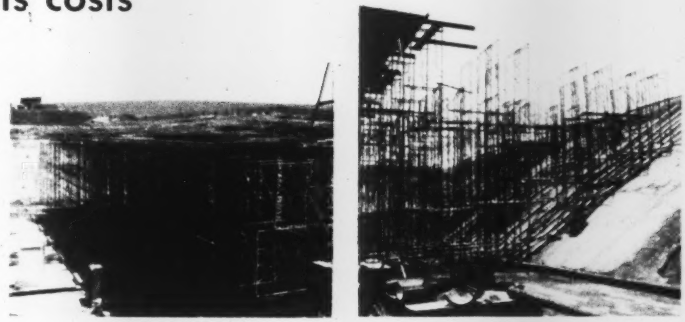
FIELD HINTS

Shoring with steel scaffold cuts costs

Efficiency of steel scaffolding for use in shoring jobs is aptly illustrated in the roofing of a 10-million-gallon reservoir, part of the six-million-dollar water system currently building in Vallejo, Calif., to service the township and large military bases in the vicinity. The program was planned and is being supervised by Kaiser Engineers of Henry J. Kaiser Co., Oakland, Calif.

The clear-water reservoir, constructed several years ago without roofing, has concrete sides, 4 to 8 in. thick, built on a slope of 1:1½. Perimeter measurements are approximately 402 × 141 × 250 × 465 ft. The contract, handled by Walsh Construction Co., San Francisco, calls for a 6-in. concrete slab roof over the entire area with drop panels over the supporting columns and is scheduled for completion in February 1953. The roofing job is a part of the Walsh Company's $3,719,000 contract, which includes contruction of a water treatment plant, a pipeline, and adaptation of present facilities to the system.

The height from the level center section of the reservoir floor to the roof is 30 ft. Beatty Scaffold, Inc., San Francisco, supplied and erected the steel scaffolding to support the roof forms. Prefabricated 6-ft 4-in. × 5-ft tubular steel end frames, four tiers high, are spaced 6 ft apart and joined with cross braces secured with hexagonal nuts. A tower of this height can be erected in one-third the time required for a wooden scaffold of the same height and can support 167 psf, or more than twice the 70 psf required of it in this job.



On contract to roof clear-water reservoir of Vallejo, Calif., use of steel scaffolding to support roof forms was found to have several advantages, including speed of erection. On steeply sloping sides of reservoir, wood supports would have called for costly variety of lumber lengths. To support forms 30 ft above floor of reservoir, prefabricated 6 ft 4-in. x 5-ft tubular steel end frames, four tiers high, are spaced 6 ft apart and joined with cross braces secured with hexagonal nuts.

The efficiency of the steel scaffolding is still more apparent in the difficult construction required by the steeply sloping sides of the reservoir. The use of wood here would call for a costly variety of lumber lengths, whereas the steel scaffold is available in sizes for ready adjustment to any heights and comes equipped with screw-jack legs by which instant adjustments can be made anywhere up to 18 in. The system of steel bracing carried from the level center area on through to the frames erected on the slopes insures absolute uniformity of shoring support, and there is no danger of "give" after alignment is achieved.

The Walsh Construction Co. has not made an exact estimate of the cost of wood scaffolding for a job of this size, but the steel scaffolding cost of this Vallejo project is approximately $15,000.

ENGINEERS' NOTEBOOK

Aerial photographs facilitate surveys of pavement condition

ADRIAN R. LEGAULT, A.M. ASCE

HOWARD M. McMASTER, J.M. ASCE

Respectively Associate Professor and Assistant Professor of Civil Engineering, The University of Nebraska, Lincoln, Nebr.

Aerial photography is becoming more and more useful in highway engineering. Its application to reconnaissance and location surveys is recognized and has been utilized on such major projects as the Pennsylvania Turnpike Extension and the Pan American Highway. Its feasibility for making pavement performance surveys, drainage studies, and soil classifications is the subject of a recent report by the Engineering Experiment Station of Purdue University.

The study here summarized was recently completed under a coopera-

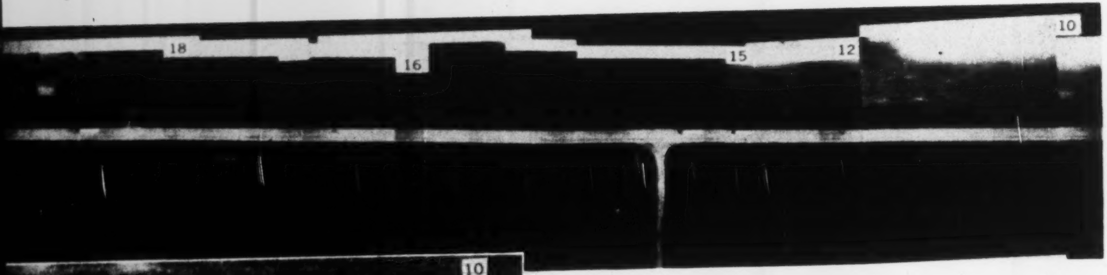


FIG. 1. Single print and mosaic taken at elevation of 500 ft above pavement, from 5-in. photographic negatives. Portion of individual print is reproduced full size; mosaic is reduced.

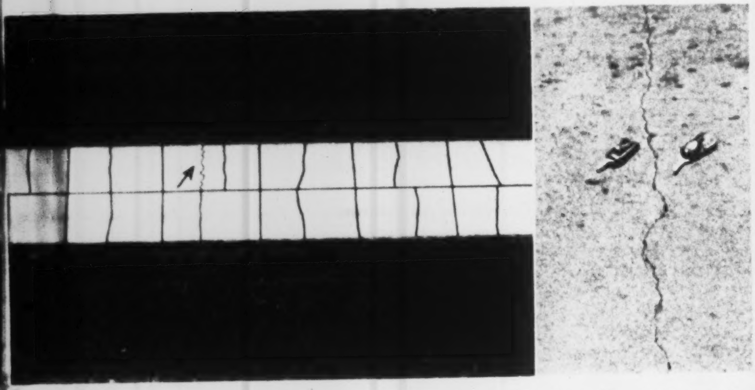


FIG. 2. Aerial photograph taken at 350-ft elevation shows untreated crack (marked by arrow) which appears in ground photo at right. Film used was 5-in. photographic negative, Super XX

tive arrangement between the Civil Engineering Department of the University of Nebraska and the Nebraska Department of Roads and Irrigation. The object of the project was to carry on from the basic work reported by Purdue in an attempt to determine techniques and procedures that would result in maximum surface detail on the aerial photographs. The entire study is reported in Bulletin No. 4 of the Engineering Experiment Station, copies of which may be obtained on request from the Department of Civil Engineering, University of Nebraska, Lincoln, Nebr.

In planning the work, a number of variables were selected and comparisons made to determine their effect on the amount and sharpness of surface detail shown in the aerial photographs. The variables selected for study were:

1. Height from which photograph is taken
2. Bright sunlight versus overcast at time of exposure
3. Variable F-stop settings on the camera
4. Normal, underdeveloped, and overdeveloped negatives
5. Normal, light, and dark printing of negatives
6. Bare ground versus snow on shoulders
7. Overlap for stereoscopic viewing versus single negative
8. Time of day when photograph was taken
9. Enlarged print versus contact print
10. Printing versus projecting the negative onto a screen for study
11. 35-mm negatives versus 5-in. strip negatives

The cameras used were a Stereo-Realist 35 mm, a Robot 35 mm, and a military type K-20. Super XX film was used for all exposures, which were at 1/500 sec. The best F-stop setting was found to be between F 4.5 and F 6.3 inclusive.

An individual print and a mosaic made up of individual prints of negatives exposed at 500 ft above the pavement are shown in Fig. 1. This elevation is considered satisfactory to show all pavement defects which have been treated but does not make it possible to locate untreated defects on the photographs. Lower elevations were tried in increments from as low as 100 ft. An altitude of 300 to 350 ft above the pavement was selected as most suitable from the viewpoints of safety and ground coverage per exposure. Figure 2 shows a photograph taken from a 350-ft elevation and a ground photograph of the untreated crack which shows up in the aerial photograph.

Exposures in bright sunlight gave somewhat better detail than those made when there was a light overcast. In this connection, notable improvement was apparent on photographs taken when the sun was from one to two hours on either side of the meridian because of the shadow cast by the crack or other defect.

In general the investigation showed that aerial photographs are a practical means of making pavement-condition surveys, including surveys which will show recent cracks and other defects in need of treatment. Its usefulness in showing the latter will facilitate efficient "preventive maintenance." It is also possible to determine when retreatment is necessary, particularly if a chronological photographic record has been kept.

Variations from standard procedure in film processing did not show any improvement in bringing out detail.

With the possible exception of certain special cases, enlarged prints and stereoscopic prints did not increase the detail discernible to a great enough degree to justify the extra expense involved.

It is necessary to obtain a chronological photographic record throughout the life of any given section of pavement if maximum use is to be made of aerial surveys of this type. This record should begin with the opening of the pavement to traffic in the case of new projects, and as soon as possible on older sections. A filing problem might eventually result if all negatives were printed. A possible solution to this problem would be to project negatives on a screen for study rather than to print them. Investigation of this possibility showed that the detail in projections is as good as that on prints. In addition to reducing the space and work required for filing, this method would result in an appreciable saving in total cost where numerous negatives are involved.

In an attempt to further reduce the bulk as well as the total cost, 35-mm film was used on some of the flights. The records thus obtained clearly showed all treated defects but were inferior to the 5-in. negative strip in showing those that had not been treated.

Cost data for "crack surveys" by ground methods is meager and difficult to obtain. However, a ground survey complete enough to determine and record the type and location of pavement defects would probably cost from $75 to $100 per mile, depending on the number of defects, details of procedure, and type of records produced. The cost of obtaining a record which is sure to be more complete on a 5-in. photographic negative will range from $8 to $10 per mile. This cost will obviously be independent of the number of defects per mile. If prints are made, the cost of the photographic method will be approximately doubled. The use of 35-mm camera would reduce the cost of the aerial method by an estimated 20 to 25 percent.

THE READERS WRITE

Electric Transmission of Water Power Adopted at Niagara Falls in 1891

To The Editor: Of interest in connection with the Centennial of Engineering, and especially Mr. Uhl's article, "One Hundred Years of Water Power," in the September issue, p. 147, is the little known story of how electric transmission of power came to be adopted in the United States for the first time at Niagara Falls. This was the first development of electric power of more than a few hundred horsepower in the world. The first plans were made in 1890.

The Niagara Falls Power Co. had as its objective the transmission of power to Buffalo and no further at first. The company had four schemes from which to choose:

1. Wire rope transmission
2. Water under pressure as the transmitting agent
3. Air under pressure as the transmitting agent
4. Electric transmission

The company's subsidiary, the Cataract Construction Co., formed to build the power development, held a meeting of its Advisory Board of Consulting Engineers at Brown's Hotel in London on June 18, 1890. The board consisted of Dr. Coleman Sellers, Philadelphia, chairman; Col. John Bogart, New York, secretary; George B. Burbank, Niagara Falls; Clemens Herschel, New York; Albert H. Porter, Niagara Falls; and Lt. Col. Theodore Turrettini, Geneva, Switzerland. All except the last were members of ASCE. Colonel Bogart established, in 1869, what is believed to be the first consulting engineering firm in the City of New York—Bogart, Culver & Harris, of which the present firm of Bogart & Pohl is the successor. Colonel Bogart also served twice as the Society's treasurer and as its secretary from 1878 to 1890. Clemens Herschel later became its president and an Honorary Member.

The Advisory Board met with the officers of the company and the International Niagara Commission, consisting of Lord Kelvin, Great Britain, chairman; Prof. E. Mascart, Paris, France; Dr. Sellers, United States; Colonel Turrettini, Switzerland; and Prof. W. Cawthorne Unwin, England. The principal agenda was to determine the answer to the most serious problem—the method of transmission of power. The electric method was tentatively selected, with direct current the most probable type.

After the meeting Messrs. Mascart and Turrettini made an inspection trip to northern France and Switzerland to look at small water-driven plants there and to interview manufacturers of machinery. Vice President Francis Lynde Stetson and Col. John Bogart went to central and southern France to see if anything had been done there in electric power transmission. They found a number of small plants in which power was transmitted, in some by wire rope, in some by air under pressure, and in a very few by electricity, where the power was under 10 kw.

On or about September 1, 1890, Mr. Stetson and Colonel Bogart visited the plant of the Chevrant Paper Mill at Domene, Isère, France (near Grenoble) where 200 kw was being transmitted 5 kilometers. The current was direct, at 2,850 v and about 70 amp. This plant was by far the largest then known to be in operation using electric transmission and was the only precedent for Niagara. The designing engineer was André Hillairet, who later received the prize from the Niagara company for submission of the only plan using 10,000 kw units or more.

Colonel Bogart, my former partner, told me about his visit to Domène. The Chevrant Paper Mill manufactured a high grade of linen writing paper and had been doing so for years, using steam for power. Shortly before 1890 a new and competing plant had been built with a hydraulic turbine as the power source. As a result of cheaper power the new mill could undersell the Chevrant mill by a little more than their profit. To meet competition they lost a small amount on each pound of paper sold.

At about this time the owner received a visit from his nephew, Mr. Hillairet, who was told of the serious competitive situation. Mr. Hillairet, a recent graduate of the Ecole Polytechnic of Paris, told his uncle that he could help him.

"How?" he was asked.

He replied, "Uncle, you know of the waterfalls at the foot of the glacier near the Chartreuse Monastery about five kilometers away. I can install a water turbine there and belt the power to a new machine called a dynamo, which will convert the mechanical power to electricity, which I will transmit over two wires to your plant and then, with another machine similar to the dynamo, convert the electricity back to mechanical power and belt it to the shafting of your mill."

His uncle asked where this had been done.

"At no place that I know of," said Mr. Hillairet.

"Shame," said his uncle, "you are a disgrace to yourself and to your family to think that you, recently out of college, can do what no one in the world has done before."

The wife of the owner had been listening to the conversation and now said to her husband, with prophetic good sense, "Don't be in such a hurry. We are going to lose all our money anyway. Give the young man a chance. If he fails, our worries will be over all the sooner."

Young Mr. Hillairet was given his chance and created the only precedent in the world for Niagara, the first large hydroelectric plant.

This story should be a splendid stimulus to all young men, especially engineers, to do some real thinking and not to believe that every worth while thing has already been done.

Dr. Charles A. Pohl
Bogart & Pohl
Consulting Engineers
New York, N.Y.

Old Iron Bridge Shows Amazing Strength

To the Editor: A sentence in Mr. Dougherty's interesting and informative article on the White House in the July issue produced a resounding echo in my mind. The sentence, in the second column of page 48, reads, "It is a wonderful thing to contemplate the abuses that materials of construction sometimes will undergo before failure."

About 1915 I was called upon to examine a bridge in Bedford County, Virginia, condemnation of which was under consideration. My memory has dimmed and any notes I may have made have vanished, but a few items are still clear and distinct.

The enclosed sketch brings out three points which were fixed in my mind: (1) the continuous bottom chord bars, (2) the L/r ratio of the vertical members, and (3) the suspension of the floor beams. I regret that I cannot recall anything about the connection of the diagonal truss members to the bottom chord except that they were not attached directly to the eyebars. How the vertical and horizontal components were compensated I cannot even suggest. At the top chord the diagonals passed through the webs of the chord channels and were secured with a single nut similar to the post connection shown. I also do not have any recollection of the lateral bracing, but assume such bracing existed.

To my mind, the most impressive thing is that two days before my examination a 10-ton road roller had crossed this bridge safely, even though the floor-beam reaction was supported by a threaded $^3/_4$-in. iron rod with a net area of 0.3 sq. in., and with forty years of rust and corrosion behind it.

James R. Hardesty, M. ASCE
Chevy Chase, Md.

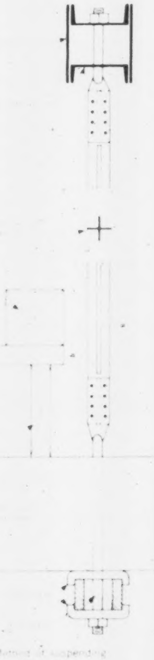


FIG. 1. In spite of details shown, this highway bridge in Bedford County, Virginia, safely carried 10-ton road roller two days before writer's examination. Bridge was built about 1873 and condemned in 1915.

Did You Vote?

To the Editor: A comparison of the figures in the tellers' report of votes cast on the first ballot, results of which determine the Official Nominees for the 1952 election of ASCE officers of the Society (as printed in the August issue, p. 85) with the corresponding membership of the respective areas as given on page 89 of the "Official Register," shown in Table I below, leads to two startling conclusions:

1. A deplorably small percentage of the membership shows sufficient interest in the direction of the Society to use the right of the ballot.
2. The percentages are lowest in the areas nearest the Headquarters and increase with distance from that point.

TABLE I.
Percentages of Members Voting for ASCE Officers

Area	No. of Members	Percentage Voting for All Candidates	Percentage Voting for Official Nominees
Zone II	6,054	13.1	6.2
Zone III	8,021	21.2	4.1, 3.0*
Dist. 1			
Total	4,670	8.0	3.7
New York City only	2,971	12.5†	5.8†
Dist. 3	923	14.8	9.5
Dist. 5	1,013	12.5	5.5
Dist. 7	1,695	17.8	16.1
Dist. 9	1,596	26.1	10.4, 7.7*
Dist. 11	4,630	19.0	12.0
Dist. 12	1,699	28.8	18.1
Dist. 16	1,935	32.7	17.1

* Two Official Nominees named
† Assuming that all votes cast were from members in New York City

It would be of interest to see what percentages of the members of the other engineering societies take part in their elections, and if a similar correlation between lack of interest and proximity to headquarters exists.

Jacob Feld, M. ASCE
Consulting Engineer
New York, N.Y.

Equation for Population Estimates Corrected

To the Editor: It has been called to my attention by Eng. Edmundo Curiel, Instituto Nacional de Obras Sanitarias, Caracas, Venezuela, that the last equation on page 36 of my article, "More Accurate Population Estimates by Means of Logistic Curves" (in the February 1952 issue, pp. 35-37), is in error. It is the logarithm of

$$me^{a_1x} = \frac{100 - P}{P}$$

and now reads

$$\log_e m \times a_1 x = \log_e \frac{100 - P}{P}$$

but should read

$$\log_e m + a_1 x = \log_e \frac{100 - P}{P}.$$

The next equation, being based on the above equation, is also in error.

The corrected equation is in the slope-intercept form of a straight line

$$y = mx + b$$

in which

$$y = \log_e \frac{100 - P}{P} \qquad m = a_1$$

$$x' = x \qquad b = \log_e m$$

By scaling off values of y in terms of P on the ordinate, a logistic grid is constructed as shown in the article, and the relationship between x and P is linear.

John E. McLean
University of Illinois

Urbana, Ill.

Challenges President Proctor's View that Individual's Rights Are Threatened

To the Editor: The annual address of ASCE President Procter, as published in the July issue, has prompted me to make use of one of the individual freedoms which he believes are disappearing by challenging several propositions in this speech. In so doing I am not attempting to defend any actions by the present administration in Washington, but am merely pointing out certain superficial over-simplifications which I believe are contained in this gloomy analysis of trends in America.

First I challenge President Proctor's assertion that the alleged totalitarian state "towards which we are moving so fast" demands the "cancellation of individual freedoms." In spite of Senator McCarthy, I have failed to note the dissolution of these individual freedoms and hence have failed to perceive our rapid drift toward totalitarianism. While the modern trends resulting in increased regulation of industry and banking, social security, minimum wage requirements, and TVA type programs have unquestionably restricted individual freedom in the economic realm, they have not interfered with the rights to free expression, worship, and voice in government—the essential issues in determining whether or not a government is totalitarian. Although I personally agree with President Proctor that an economic system founded on free enterprise is preferable to a more controlled system, I do not equate economic freedom with fundamental human rights. The legal requirement that employers pay a minimum wage is no more an infringement of individual liberty than is a 50-mph speed limit.

I also challenge President Proctor's statement that "statism, in its insidious usurpations of the rights, liberties, and incentives of the individual, may in its end result be more permanently destructive of human rights than Communism, because it is being approached through a perversion of the democratic process." Apparently the support for this extravagant claim is the attempted steel seizure, certainly a gross exaggeration of its importance regardless of how much one might disapprove of it. The American people are as free as ever to elect the candidates of their choice to public office, and surely this is the acid test of the democratic process.

Certainly it is true, as President Procter points out, that the engineer can no longer hide behind his slide rule but must broaden his interest and participation in public affairs. However, I believe that engineers should exert their influence in affairs involving essentially political issues as individuals rather than through their organizations. From his speech I obtained the impression that President Proctor would have the Society follow in the wake of his private political convictions. In my opinion, the ASCE should refrain from such actions as joining with the American Medical Association in its fight against government-subsidized health insurance, if this is what is meant by "socialized medicine," until the personal views of its members can be ascertained.

Charles W. Griffin, Jr., J.M. ASCE
Dorfman & Bloom
Consulting Engineers

Philadelphia, Pa.

President Proctor Replies

To the Editor: While it is somewhat disappointing to learn that some statements in my annual address are subject to interpretations at wide variance with those intended, it is encouraging that the address has stimulated broad interest, as evidenced by the number of letters that I have received in comment.

No suggestion of partisan political position should be read into that talk and certainly none was intended. Rather, the theme was definitely intended to point up the present trend toward collectivism in this country, while our electorate is apparently largely unaware of what is actually happening. Present confusion of politico-economic thinking can be clarified only by the type of direct analysis for which the engineer is so well equipped. This confusion has been significantly influenced by failure on the part of the engineer to carry through his responsibilities for the social economic impacts of his inventions and innovations and to assure that the destructive potential of engineered science will not get completely out of control. My address was designed to awaken the engineers of the Western world to the compelling demand for their immediate acceptance of leadership in public affairs in opposing the advance of collectivism.

Collectivism is government enterprise replacing private endeavor. It is the individual existing for the government as opposed to our tradition of government as the servant of the individual. It is based on the fallacious assumption that government can give us more than it has previously taken away from us. It destroys those essential factors to our nation's progress—incentives to work, to save, to compete, to risk effort and savings, and to profit. It substitutes paternal centralized planning, direction, and promised security. It presupposes the existence and availability of supermen for superhuman performance.

Whether in the garb of communism, fascism, or socialism, collectivism must rely on controls that constantly beget more controls over individual activity, choice, and decision.

Carlton S. Proctor, *President* ASCE
New York, N.Y.

Irrigation Financing Proposals Scored

To the Editor: There has been considerable discussion lately of two proposals being made to Congress and the public. They are:

1. The Basin Account
2. The Interest Component

The Basin Account is a proposal to consider federal reclamation and power projects in the Columbia River Basin (and this undoubtedly would be extended to other river basins) as part of a single development. All payments for reimbursable costs that now go to the Treasury would be diverted to this single Basin Account from power developments by the Bureau of Reclamation and by the Corps of Engineers of the Army. The essence of the Basin Account Plant therefore is to pool all power revenues in excess of those needed for operation and maintenance and make them available, in part at least, for irrigation subsidies. One example of such subsidies would be reclamation costs in excess of those the settlers are able to pay.

For example, the cost of the Columbia Basin Irrigation Project of about a million acres when completed will be upwards of $500 per acre. The settler is only expected to pay $85 per acre. The remainder, amounting to $400 million or more, will be paid from power revenues taken from the Basin Account.

This simply means that the power consumer in the Northwest will be handed a $400 million subsidy bill in favor of the settlers on the project, that he would not have to pay if the postage stamp power rates were limited to liquidating the cost of operation, maintenance, replacements, administration and amortization with interest, of power developments by the Federal Government. The Mountain Home Project in Idaho will cost about $1,500, and the Central Arizona Project, some $2,000 per acre. Why should we spend such fantastic sums to irrigate lands in the West when there are millions of acres in the East that by proper tillage, crop rotation, fertilization, and drainage can be brought into practically equivalent food production at from 2 to 10 percent of those per acre costs? As a matter of fact the government now has in storage an enormous tonnage of surplus foodstuffs. Our present production greatly exceeds our demand. When the pressure of population on our food supplies becomes serious, perhaps in the next second or third generation, there will be time enough then to consider irrigation projects at such fantastic costs.

The Interest Component. In a regional power development, postage-stamp power rates must be established for the entire region. These rates must be sufficient to meet the costs of operation and maintenance, replacements, amortization, interest and, if these proposals prevail, irrigation subsidies.

The Solicitor of the Department of the Interior has ruled that the interest involved in the liquidation of the costs of the Bureau's power developments can be impounded and used as an irrigation subsidy. The settler on the irrigation projects pays no interest, but federal funds cannot be supplied for irrigation projects without paying interest. Then who pays the interest, which may involve billions of dollars? You guessed it—the long-suffering taxpayer.

Both the Basin Account and the Interest Component therefore are merely devices to bypass Congress and to dip deeply into the pockets of the general taxpayer. Both are economically unsound and should not be countenanced.

J. C. STEVENS, M. ASCE

Stevens & Thompson Engineers
Portland, Ore.

Methods of Finding Peak Flood Flows Correlated

TO THE EDITOR: The article in the June issue by A. H. Davison, on "Methods of General Application Developed for Finding Peak Flood Flow," has been read with interest by many of our engineers. Mr. Davison certainly is to be commended for his efforts to improve techniques for determining peak flows.

The U. S. Geological Survey has been concerned for many years with the computation of peak discharges by indirect methods. Currently an intensive program of field and laboratory research is being operated for the purpose of improving techniques for such determinations as well as establishing well founded values of roughness coefficients under conditions where discharges are known. Past and present experience gives grounds for confidence in the results of applying indirect methods, a confidence which is shared by other governmental agencies and private users of these figures. The implication that many flood records are 50 percent or more high is not borne out by experience, which indicates generally favorable results as confirmed by later current meter measurements or other independent methods.

Following the publication of Mr. Davison's article, unsolicited memorandums were received from various Survey engineers who are interested in this problem (R. W. Carter, A. M. ASCE, and H. J. Tracy, Atlanta, Ga.; C. H. Hardison, A.M. ASCE, Washington, D. C.; L. L. Laine, A. M. ASCE, Oklahoma City, Okla.; S. E. Rantz, A.M. ASCE, San Francisco, Calif., and M. A. Benson, A.M. ASCE, Washington, D. C.). This letter summarizes their findings.

The author's method offers no solution for the simplest possible case, that of a uniform channel, since the method necessarily makes use of the difference in velocity heads.

The method assumes that the discharge may be separated into two portions. The first, Q_a, is the discharge which would correspond to uniform flow in the same channel with slope, S_a, equal to the slope of the water surface. The second, ΔQ, is the discharge attributed to the energy slope caused by the difference in velocity heads. The method assumes that the Manning equation can be applied to both discharges, and that the relation between Q and n for each separate portion would be the same. This artificial separation is questionable. For example, the equation for Q_a, $Q_a = \frac{K_1 S_a^{1/2}}{n_a}$, is fictitious. The term K_1 involves end areas which are different in size. Yet it is impossible for the energy gradient to have a slope of S_a, as long as the end areas differ in size.

Manning's equation,

$$Q = \frac{1.486}{n} \times AR^{2/3}S^{1/2}$$

is strictly applicable to a single cross section. In order to compute the discharge through a non-uniform reach of channel and thus to consider the effect of change in velocity heads, it is necessary to combine it with Bernoulli's equation. When so combined, it remains an equation with two unknowns, Q and n. All the other terms can be computed from field data. Values of n are usually assigned based on experience. Without doing so, there is no way of solving for Q. Mr. Davison has attempted to do so by making an arbitrary and questionable assumption. The primary assumption used is as follows:

"The principle that stream flow follows the path of least resistance is recognized by stating that the ratio $(\Delta Q)/(\Delta S)$ must be a maximum for the channel conditions."

There is no theoretical basis for this condition.

The ratio $(\Delta Q)/(\Delta S)$ can be expressed as

$$\frac{Q - Q_a}{\frac{Q^2}{2g}\left(\frac{1}{A_1^2} - \frac{1}{A_2^2}\right)} \quad \text{or} \quad \frac{Q - Q_a}{KQ^2}$$

The value of this ratio will be a maximum when the first derivative of $\frac{Q - Q_a}{KQ^2}$ is equal to zero. It will be found the $(\Delta Q)/(\Delta S)$ always attains a maximum when Q is equal to $2Q_a$. It is obvious that such a relationship is unreasonable, since this would seem to imply that a slight nonuniformity in any open channel would automatically cause the discharge to be twice that in a similar uniform channel.

However, even assuming that the solution for the maximum value of $(\Delta Q)/(\Delta S)$ is valid, the method of determining the constant, Q_a, is not. Mr. Davison accomplishes this by the solution of two simultaneous equations:

$$n = \frac{\text{constant}_1}{\left(\frac{Q \times \text{constant}_2}{10{,}000}\right)^{\text{constant}_3}} \qquad (1)$$

$$Q_a = \frac{K\, S_a^{1/2}}{n} \qquad (2)$$

Equation 1 is derived from a log plot of the points computed in Table II. This is an approximate empirical equation

(*Continued on page 100*)

THE INTER-AMERICAN CONVENTION OF CIVIL ENGINEERS

SPONSORED BY THE PUERTO RICO SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

CELEBRATING A CENTURY OF ENGINEERED PROGRESS 1852–1952

HEADQUARTERS: CONDADO BEACH HOTEL   SAN JUAN, PUERTO RICO   NOV. 12–16, 1952

REGISTRATION

Condado Beach Hotel, Mezzanine. Opens 7:00 p.m., Tuesday, Nov. 11. Until 10:00 p.m. that day and each day, 9:00 a.m. to 5:00 p.m. through Nov. 14.

Registration fee, except ladies and students, $3.00

AUTHORS' BREAKFASTS

Briefing sessions for all speakers, discussers and program officials by invitation

Presiding: Rafael A. Gonzalez, M. ASCE, Technical Program Chairman

1. **Wednesday, Nov. 12, 8:15 a.m.**
Condado Beach Hotel, for participants in Wednesday Division sessions.

2. **Thursday, Nov. 13, 8:15 a.m.**
Condado Beach Hotel, for participants in Thursday Division sessions.

3. **Friday, Nov. 14, 8:15 a.m.**
Condado Beach Hotel, for participants in Friday Division sessions.

WEDNESDAY MORNING

NOVEMBER 12

Institute of Engineers, Architects and Surveyors (El Colegio de Ingenieros). Transportation to and from the Institute building will be furnished.

Presiding: William C. Hill, President, Puerto Rico Section, ASCE

10:00 **Opening of Convention**

10:10 **Address of Welcome**
The Hon. Luis Munoz Marin, Governor of Puerto Rico, or his representative.

10:30 **Response**
Carlton S. Proctor, Past President, ASCE

10:45 **Greetings from Inter-American Delegations**

11:10 **The Business of the American Society of Civil Engineers**
William N. Carey, Executive Secretary, ASCE.

11:40 **Historical Facts About Puerto Rico**
Adolfo de Hostos, Historian of Puerto Rico.

LUNCHEON

12:30 p.m.

At Institute of Engineers, Architects and Surveyors Building, as guests of the Institute

Presiding: Etienne Totti, M. ASCE, Consulting Engineer, General Chairman of the Convention

H. G. Baity, M. ASCE, Director, Division of Environmental Sanitation, U. N. World Organization, Geneva, Switzerland, will address the luncheon on the subject "The Opportunity of the Engineer in World Health Work."

WEDNESDAY AFTERNOON

NOVEMBER 12

Soil Mechanics and Foundations Division

GOVERNOR'S ROOM
CONDADO BEACH HOTEL

2:00 **Design and Construction of Neusa Dam, Colombia**
Ralph B. Peck, M. ASCE, Research Professor of Soil Mechanics, University of Illinois, Urbana, Ill., and Albert E. Cummings, M. ASCE, Director of Research, Raymond Concrete Pile Co., New York, N.Y.

2:45 **Subsoils in San Juan Harbor**
Cesar S. Canals, M. ASCE, Manager, The Frederick Snare Corp., San Juan, Puerto Rico

3:30 **Procedure for Soil and Foundation Investigations**
George F. Sowers, A.M. ASCE, Associate Professor of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga.

Highway Division

ROOM 101-102
CONDADO BEACH HOTEL

2:00 **Recent Developments in Use of Asphalts for Highways, Airports and Hydraulic Structures**
Herbert Spencer, District Engineer, The Asphalt Institute, New York, N.Y.

2:45 Autopista Caracas–La Guaira – Construccion de Viaductos en Concreto Precomprimido

(Construction of Prestressed Concrete Viaducts on the Caracas–La Guaira Expressway)

Henrique Sibiesz, Administrative Director, Ministry of Public Works, Caracas, Venezuela.

3:30 Sand-Well Treatment

Waterways Division

ROOM 301-302
CONDADO BEACH HOTEL

2:00 Some Practical Facts about Beach Erosion in Florida
Morris N. Lipp, M. ASCE, City Engineer, Miami, Fla.

Irrigation and Power Divisions, Joint Session

ROOM 303-304
CONDADO BEACH HOTEL

2:00 Planning and Development of Water Resources in Colombia and Venezuela
Royce J. Tipton, M. ASCE, Consulting Engineer, Royce J. Tipton and Associates, Denver, Colo.

2:45 Water Requirements for Irrigation in Haiti
George H. Hargreaves, A.M. ASCE, Institute of Inter-American Affairs, Port au Prince, Haiti

3:00 The Antibonite Irrigation and Power Development in Haiti

COCKTAILS FOR VISITORS

5:30 p.m.

At the Institute of Engineers, Architects and Surveyors, as guests of the Institute. Transportation to and from the Institute will be furnished.

BUFFET DINNER AND DANCE

7:30 p.m.

Condado Beach Hotel. For visitors to the Convention. Informal. $8.00 per plate.

THURSDAY MORNING NOVEMBER 13

Soil Mechanics and Foundations Division

ROOM 101-102
CONDADO BEACH HOTEL

9:30 Soil Deposits and Foundation Problems in Puerto Rico
Don U. Deere, A.M. ASCE, Partner, The Foundation Engineering Co. of Puerto Rico, San Juan, Puerto Rico

10:15 The Alteration of Soil Behavior by Minute Amounts of Chemicals
T. William Lambe, J.M. ASCE, Assistant Professor of Soil Mechanics, The Massachusetts Institute of Technology, Cambridge, Mass.

Hydraulics Division

ROOM 301-302
CONDADO BEACH HOTEL

9:30 The Engineering Features of TVA
C. E. Blee, M. ASCE, Chief Engineer, Tennessee Valley Authority, Knoxville, Tenn.

10:15 Intrusion of Sea Water in Tidal Sections of Freshwater Streams
C. B. Lindner, M. ASCE, Colonel, Corps of Engineers, U.S. Army, Chief Engineer, South Atlantic Division, Atlanta, Ga.

11:00 Martin Dam Draft-Tube Modifications, Based on Hydraulic Model Studies
Carl E. Kindsvater, M. ASCE, Professor of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga.; and R. R. Randolph, Hydraulic Engineer, Southern Services, Inc., Birmingham, Ala.

Air Transport Division

ROOM 303-304
CONDADO BEACH HOTEL

9:30 Concrete Pavements for Puerto Rico International Airport
Rafael Seijo Tizol, Chief Engineer, Puerto Rico Transportation Authority, San Juan, Puerto Rico

10:15 Air Traffic Forecast for Puerto Rico International Airport
Walter Prokosch, with Knappen Tippetts Abbett McCarthy, New York, N.Y.

LUNCHEON AT CONDADO BEACH HOTEL

12:30 p.m.

Presiding: Wm. C. Hill, A.M. ASCE, President, Puerto Rico Section, ASCE

Gustavo Padilla, A.M. ASCE, Secretary of the Institute of Engineers and Architects, will address the luncheon "On Legal Aspects of Engineering". $3.50 per plate

THURSDAY AFTERNOON

NOVEMBER 13

Structural Division

ROOM 101-102
CONDADO BEACH HOTEL

2:00 Trends in Design and Construction of Precast Concrete Structures
A. Amirikian, M. ASCE, Chief Designing Engineer, Bureau of Yards and Docks, Department of the Navy, Washington, D.C.

2:45 Bridge Girders of Box Section
Homer M. Hadley, M. ASCE, Consulting Engineer, Seattle, Wash.

3:00 Suggested Modifications and Limitations to Empirical Method of Flat-slab Design
J. Di Stasio, M. ASCE, Di Stasio and Van Buren, Consulting Engineers, New York, N.Y.

3:45 Use of the Conjugate Structure in Analysis of Continuous Frames
J. Sterling Kinney, A.M. ASCE, Head of Division of Structural Engineering, Rensselaer Polytechnic Institute, Troy, N.Y.

Hydraulics Division

ROOM 301-302
CONDADO BEACH HOTEL

2:00 Flood Control in the Everglades
Herman W. Schull, Jr., Colonel, Corps of Engineers, U.S. Army, District Engineer, Jacksonville, Fla.

2:45 Modern Needs for Reliable Records of Stream Flow and Water Levels
A. O. Patterson, A.M. ASCE, District Engineer, U.S. Geological Survey, Ocala, Fla.

3:30 High Intensities of Rainfall and Major Floods in Puerto Rico
Miguel Angel Quinones Castro, A.M. ASCE, Head Design Engineer, Puerto Rico Water Resources Authority, San Juan, Puerto Rico

Surveying and Mapping Division and Puerto Rico Section of AIEE, Joint Session

ROOM 303-304
CONDADO BEACH HOTEL

2:00 **Importance of Shoran Surveying in Southern Hemisphere**

Carl I. Aslakson, M. ASCE, Commander and Geodetic Officer, U.S. Coast and Geodetic Survey, Patrick Air Force Base, Fla.

2:45 **Electronic Communications in Puerto Rico**

Jose V. Dominguez, M. AIEE, General Manager, Puerto Rico Telephone Co., San Juan, Puerto Rico

CONVENTION DINNER AND DANCE

8:00 p.m.

Caribe Hilton Hotel. Formal. $10.00 per plate

FRIDAY MORNING

NOVEMBER 14

Structural Division

ROOM 101-102
CONDADO BEACH HOTEL

9:30 **Earthquake and Blast Effects on Structures**

C. Martin Duke, A.M. ASCE, Associate Professor of Engineering, University of California, Los Angeles, Calif.

10:15 **Deflection of Rigid-Frame Structures**

J. M. English, A.M. ASCE, Lecturer, University of California, Los Angeles, Calif.

11:00 **Design of Structures Against Winds of Hurricane Force**

O. S. Jorgensen, Jorgensen and Schreffler, Structural Engineers, Miami, Fla.

Sanitary Engineering Division

ROOM 301-302
CONDADO BEACH HOTEL

9:30 **Los Desperdicios Industriales y su Disposicion**

(Industrial Wastes and Their Disposition)

George E. Barnes, M. ASCE, Head, Department of Civil Engineering and Engineering Mechanics, Case Institute of Technology, Cleveland, Ohio

10:15 **Sanitation in Rio Grande de Loiza Watershed, of Puerto Rico**

Mortimer M. Gibbons, M. ASCE, Sanitary Engineer, Puerto Rico Aqueduct Authority, Santurce, Puerto Rico

LUNCHEON AT FILTRATION PLANT

12:30 p.m.

Luncheon at Loiza Filtration Plant of Puerto Rico Aqueduct Authority

Transportation to and from the plant will be furnished. $3.50 per plate.

Following the luncheon, the guests will be taken on a tour of the plant and of other engineering works in the Metropolitan Area.

SATURDAY

NOVEMBER 15

Motorcade Excursion

Motorcade excursion across the mountains to Ponce, on the south coast, with luncheon as guests of Empresas Ferre (Ponce Cement Works and Puerto Rico Iron Works) and dinner as guests of Empersas Serralles (Don Q. Rum).

The night will be spent at various hotels on the south and west coasts of the island and the group will be luncheon guests on the following day, Sunday, November 16, of the College of Agriculture and Mechanic Arts of the University of Puerto Rico at Mayaguez and of the Student Chapter of the American Society of Civil Engineers at that institution.

Return will be made to San Juan during the afternoon.

AIR TRANSPORTATION TO PUERTO RICO

Various daily flights from both New York and Miami facilitate your travel to San Juan, the Convention city. Both Eastern Airlines and Pan American Airways serve travelers with several types of accommodations. Fares and schedules are available from your nearest airlines ticket office. A round trip excursion rate of $172.50 from New York, and $132.28 from Miami, is offered, both including tax.

LADIES' ENTERTAINMENT

Wednesday, November 12

12:30 **Luncheon at The Mallorquina**

This old Spanish restaurant is over one hundred years old and the cuisine is both Spanish and American. The service is a la carte.

Meet at the Ladies' Reception Desk on the Mezzanine of the Condado Beach Hotel and visiting ladies will be conducted by members of the Ladies' Reception Committee.

The afternoon will be devoted to sight-seeing in old San Juan, followed by a call at The Forteleza, the Governor's residence, on the First Lady of Puerto Rico, Dona Ines Munoz Marin.

Thursday, November 13

The whole day will be occupied with visits to the fascinating shops of San Juan, or nearby points of scenic beauty.

Friday, November 14

A fashion show, with ballet and Spanish dancing, has been arranged for at the Tapia Theater. There will be no charge for this entertainment. Tickets will be available at the Ladies' Reception Desk.

HOTEL ACCOMMODATIONS

Headquarters for the Inter American Convention of Civil Engineers will be in the Condado Beach Hotel, November 12 through 16. For reservations at the Condado Beach Hotel, send your request promptly to: Condado Beach Hotel, Reservation Manager, San Juan, Puerto Rico, or use the handy coupon on page 94 of this issue.

CONVENTION COMMITTEES

General Committee
Etienne Totti, *Chairman*

Technical Program Committee
Rafael A. Gonzalez, *Chairman*

Reception and Registration Committee
Franklin O. Rose, *Chairman*

Transportation Committee
Salvador V. Caro, *Chairman*

International Relations Committee
Etienne Totti, *Chairman*

Publicity Committee
William C. Hill, *Chairman*

Finance Committee
Raoul Arroyo, *Chairman*

Hotel Registration Committee
Robert J. Aued, *Chairman*

Entertainment Committee
Jose M. Canals, *Chairman*

Ladies' Committee
Mrs. William C. Hill, *Chairman*

SOCIETY NEWS

ASCE
N to Z
REGISTER HERE
A.S

World's Largest Gathering of Engineers Celebrates Centennial of Engineering

Chicago, the hub of the nation, became the hub of the engineering world when 27,964 professional men from all parts of the free world assembled there for the Centennial of Engineering, September 3-13. The story of the convention can be told only in part by the tremendous number of excellent technical sessions, attended by 2,600 ASCE members and bringing together the finest minds in the engineering profession in what was probably the best technical program yet heard by the Society. It would be futile to try to name the most notable speakers in a program of such uniformly high quality. Nor would it be possible to point to the technical sessions found most interesting when so many sessions had room left only for standees. The joint ASCE-ACI sessions on prestressed concrete had to be moved to the Grand Ballroom of the Conrad Hilton when an audience of 900 unable to get into the North Ballroom jammed third-floor corridors. ASCE Honorary Member Karl Terzaghi's opening remarks to the Soil Mechanics and Foundations Division program were addressed to over 400.

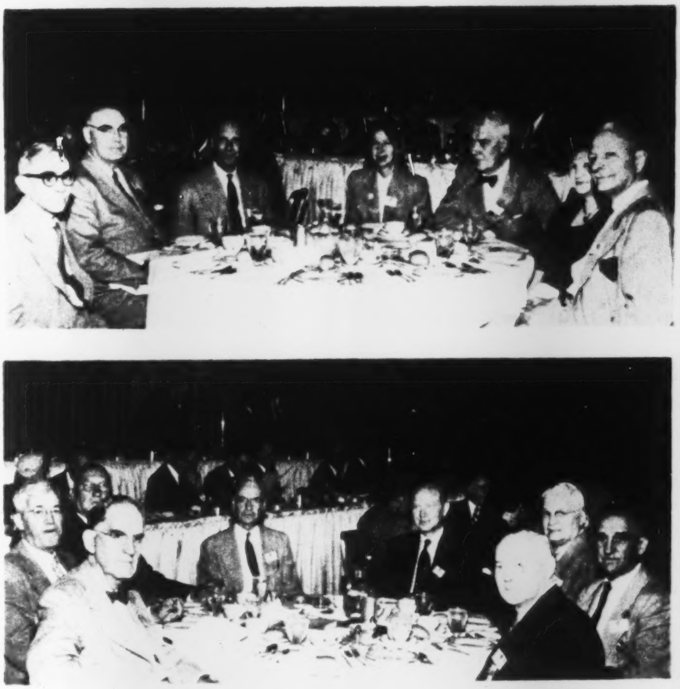
To refer only to the technical aspects of the meeting, however, would be to overlook perhaps the most striking feature of the ten-day celebration. To this observer, the universality of the gathering was most significant. No session could be found where there were no Europeans or South Americans, or other engineers from abroad. At breakfast, luncheon, cocktails or dinner one was never more than a table or two from some visitor from Great Britain, Norway, Nepal, Mexico, Uruguay, Japan or elsewhere. This implies more than an international flavor to the celebration. The feeling at the Convocation was one of unity—men of high intellect bound together by a mutual interest in the design and construction of engineering works.

If any one thought or idea were to be chosen as more dominant than any other it would have to be the awareness of the engineer's responsibility to the public for his creations. The idea that engineers must also accept their political and social responsibilities seemed to flow through all discussions of a general nature.

Perhaps the most impressive ceremony during the centennial celebration was the presentation of honorary membership in ASCE at the Saturday evening dinner—to Ervin G. Bailey of New York, André

G. Donald Kennedy, chairman of Coordinating Committee on Technical Programs (top photo), is among early Convocation registrants. To his left is ASCE Director G. Brooks Earnest (to be installed as Vice-President in October). Center view shows ASCE President Carlton Proctor with Herbert Hoover, Hon. M. ASCE, whose address at Centennial Day luncheon was one of high spots of ten-day program. Engineers inducted into honorary membership at ASCE Centennial Day dinner are shown with Mr. Proctor at left. They are Andre Coyne, E. G. Bailey, Mr. Proctor, Chalmers J. Mackenzie, Ary F. Torres, and Harvey S. Mudd.

Viewed at Saturday Awards Luncheon (upper photo, reading clockwise) are Mr. Frost, refrigeration engineer from Montreal; James A. Vance, M. ASCE and former president of Engineering Institute of Canada; Allan S. Quartermaine, president of Institution of Civil Engineers (Great Britain); Mrs. J. B. Stirling, of Montreal; Graham Clark, secretary of Institution of Civil Engineers; Mrs. Vance; and Austin Wright, secretary of EIC. Grouped around lower table are ASCE Vice-President W. R. Glidden, of Richmond, Va.; Vice-President D. V. Terrell, of Lexington, Ky.; Charles W. Bryan, former Director of Chicago, Ill.; Harold L. Blakeslee, former Director of New Haven, Conn.; Lorenz G. Straub, director of St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minn.; Ralph Wiley, former Vice-President of West Lafayette, Ind.; Director Frank L. Weaver, of Washington, D. C.; and Director Otto Holden, of Toronto, Canada.



Coyne of France, Chalmers J. Mackenzie of Canada, Harvey S. Mudd of Los Angeles, and Ary F. Torres of Brazil. One could not help but be impressed by the contribution of this group to the well being of their fellowmen.

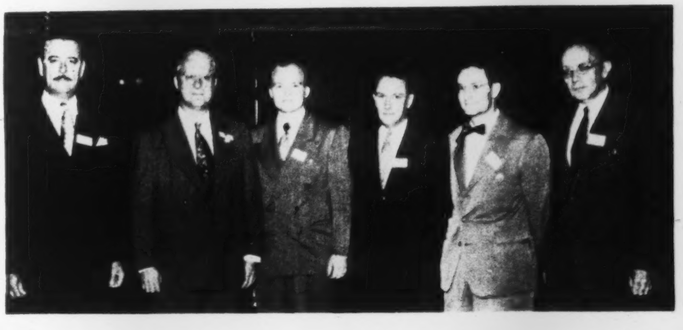
Hoover Addresses Centennial Luncheon

The Centennial luncheon, during which the John Fritz and Hoover medals were awarded, was another high spot of the celebration. Herbert Hoover, Hon. M. ASCE, in his address to the assembled engineers, declared that "... scientific discovery and the inventions by engineering productivity have periodically saved the world from impoverishment by the wars created through lost statesmanship. That is the hope of our nations today.

"And let me add that bureaucracies do not produce these wonders in scientific discovery or invention. Governments can at times advantageously subsidize research or pioneering of the application of known discoveries.

"However, it is dynamic men and women, free in mind and spirit, who make these human advances. The decadence of scientific research in Germany under Hitler is a lesson to the world."

Andre Coyne, of Paris, France, receives honorary membership in ASCE from President Carlton Proctor at ASCE Centennial Day dinner. Applauding ceremony is Mrs. Proctor, and behind her stands ASCE Past-President Gail A. Hathaway.



Six of eight winners of prizes for papers appearing in Volume 116 of "Transactions" (1951) are present for award ceremony held during Centennial Convocation. Shown at right, in usual order, are John N. Newell, Construction Engineering Prize (for paper in "Civil Engineering"); Donald J. Bleifuss, James W. Rickey Medal; Harold R. Henry, J. C. Stevens Award; John M. Kyle, James Laurie Prize; T. William Lambe, Collingwood Prize for Juniors; and Clarence E. Keefer, Thomas Fitch Rowland Prize.

Many notables are seated at speakers' table for Centennial Day luncheon, Wednesday, September 10. Shown left to right are E. L. Chandler (in profile view) Assistant Secretary of ASCE and Convocation manager; Robert E. Wilson, president, Standard Oil Co. of Indiana; the Rev. Theodore M. Hesburgh, president, Notre Dame University; Ralph Budd, chairman, Chicago Transportation Authority; Carlton S. Proctor, President of ASCE; Richard E. Dougherty, Past-President of ASCE and chairman, John Fritz Medal Board of Award; Clarence D. Howe, Canadian Minister of Defense Production and recipient of

T. C. Forrest, Jr., of Dallas, Tex., president of Texas Section (above, right) receives first sheet of ASCE commemorative stamps sold in Dallas. Sale was made by Dallas Postmaster J. Howard Payne. In upper photo, J. B. Stirling, president of Engineering Institute of Canada, presents EIC gift of clock for ASCE to President Proctor

Benjamin Fairless Receives John Fritz Medal

In acknowledging the receipt of the John Fritz Medal, Benjamin Fairless, M. ASCE, thanked the speakers for their kind words, noting that: "If you had been called as many purple names as I have during the past few months, you would know how nice it is to hear a dissenting opinion."

In speaking of his engineering education, Mr. Fairless pointed out that the engineer "must know his facts completely and exactly . . . if he is only 99 percent right, he is likely to be 100 percent wrong. And so it is, of course, with anything else which men build—whether it be an open hearth, an economic system, or a government. All of them must be engineered in strict accordance with the facts, and the builder who tries to remodel our economy, and who twists those facts to conform to his personal wishes, his emotional whims, or his political theories, is courting disaster for us all."

The Right Hon. C. D. Howe, M. ASCE, the first Canadian to receive the Hoover Medal, spoke of the changing times. "We have all, I think, been forced to the conclusion, by the harsh realities of our times, that neither men nor nations can afford to remain unconcerned about the destiny of other men, or other nations.

"We as engineers, by our technological achievements, took a prominent, if unconscious, part in bringing about this change of attitude. It was the application of our technology that made the world smaller and more interdependent. It seems to me that, in time, we must and should take an active part in the attempt to solve the problems we have helped to create."

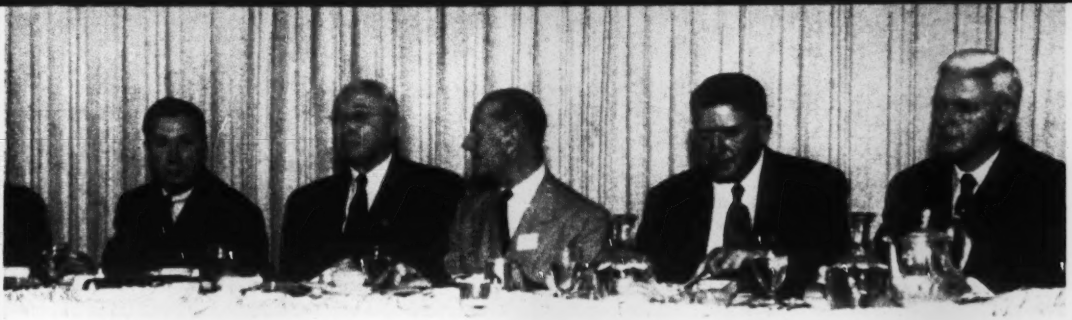
Greetings—presented to the ASCE in the form of beautifully executed scrolls, certificates, medallions and plaques by 66 engineering societies from all over the world—were spoken by Allan S. Quartermaine, London, President, The Institution of Civil Engineers.

Perhaps the most important element of the celebration was the fact that 66 engineering societies from throughout the free world met at the same time as did the ASCE. This opportunity for men of the various branches of the profession to get together, to meet and talk with one another should prove as valuable to the synthesis of the profession as any step yet taken towards unity.

The largest dinner of the entire celebration was held the last Wednesday evening when some 2,500 engineers and their ladies representing all branches of the profession gathered at the International Amphitheater in the Chicago Stockyards, stuffed themselves with roast beef, heard ASCE Honorary Member Charles Kettering, and watched a preview of Sonja Henie's 1953 Ice Show.

The work of many went into the success of the meeting. Prominent among these were Howard Peckworth, G. Donald Kennedy, and E. L. Chandler. The success of the centennial can be directly traced to these capable men. The success of the entire joint venture in celebrating 100 years of engineered progress could well point the way to further unified action by all members of the engineering profession.

One of many displays set up at Conrad Hilton during Convocation was this exhibit of U. S. Geological Survey, depicting status of topographic mapping in United States. In foreground are Carl M. Riedel, of Chicago, and Alfred C. Stiefel of USGS staff, Washington, D.C.



Hoover Medal; ASCE Honorary Members Charles F. Kettering and Herbert Hoover; Lenox R. Lohr, president, Centennial of Engineering, 1952, Inc.; Benjamin F. Fairless, president, U. S. Steel Corp. and recipient of John Fritz Medal; Scott Turner, chairman, Hoover Medal Board of Award; Allan S. Quartermaine, president, The Institution of Civil Engineers (Great Britain); Eugene Holman, president, Standard Oil Co. of New Jersey; and Martin H. Kennelly, mayor of Chicago.

ASCE-AGC Joint Cooperative Committee Meets in Chicago

A meeting of the ASCE-AGC Joint Cooperative Committee, held in Chicago on September 3, was another Centennial feature. The agenda included a discussion of recent developments in the area of critical materials controls, headed by A.N. Carter, manager of the Highway Division of AGC and co-secretary of the Committee. The committee approved recent relaxation of construction controls and urged further efforts in the same direction.

Engineers in Short Supply

The engineer supply situation was reviewed briefly by ASCE Past-President Gail A. Hathaway, special assistant to the Chief of Engineers, Washington, D.C., who praised efforts of the EJC Engineering Manpower Commission to cope with the shortage. Particularly commendable, he said, is its work in encouraging high school students to choose engineering as a vocation and in improving the policies of the armed forces on the use of engineering skills. The committee expressed concern over the lack of representation of the construction industry on the EMC and urged that the AGC suggest representatives, particularly in the New York area, who could be of assistance to the Commission.

Engineers' Salaries Discussed

In a discussion of engineers' salaries, the committee decided that the Salary Stabilization Board's interpretation 12 defining engineers "is a step forward" in giving them "true professional status," and that the new federal law amending the Defense Production Act is a "piece of sound legislation" that serves to eliminate the uncertainties of the previous act. It was the consensus of the group that such salary reports as that recently made by ASCE have "a beneficial influence on the salary picture and result in adjustment of salary inequities in government agencies." It was reported that ASCE expects to resurvey the salary situation in its field every two years, and the AGC representatives agreed to cooperate fully in such surveys.

Congressional Activities Reviewed

In a survey of Congressional action to offset the effects of the Supreme Court decision in the recent Wunderlich case, the committee again recommended that both the AGC and ASCE continue to work for prompt corrective legislation at the next session of Congress. Following a report of Congressional action on the highly controversial bill, S2907, which would require general contractors to list their subcontractors and the amounts of such contracts in their bids for federal projects, the committee recommended action opposing such legislation.

Alternate Designs Discussed

Discussion of the requirements of some government agencies that general contractors submit alternate designs led to

MONTEVIDEO
URUGUAY

Impressive bronze plaque (above), gift of UPADI engineers to ASCE for its headquarters building in New York, is one of many handsome tributes received. In top photo, stamp album of signed sheet of Centennial stamps is presented to ASCE Past-President Gail Hathaway by Assistant Postmaster General Robert E. Fellers during stamp-issuing ceremonies. President Proctor applauds.

Puerto Rico

William C. Hill (right in right-hand photo) of Puerto Rico, urges guests attending Convocation to attend forthcoming Inter-American Convention of Engineers in San Juan. Admiring the native hats are Andre Coyne, Paris; Karl Terzaghi, Boston; and Francisco J. Serrano, Mexico City.

unanimous agreement that such alternate designs cannot be evaluated fairly. The committee asked reaffirmation of its stand previously adopted against the requirement.

Joint Committee Personnel

ASCE representatives, in addition to Mr. Hathaway, were C. E. Beam, assistant to the Secretary, ASCE, and co-secretary to the committee; Maurice Quade, partner in the New York firm of Parsons, Brinckerhoff, Hall & MacDonald; and Robert K. Lockwood, associate editor of CIVIL ENGINEERING. The AGC was represented by Dwight Winkelman, former president of the AGC and president of the D. W. Winkelman Co., Inc., Syracuse, N.Y.; Augustine Ayers, vice president and chief engineer of the Utah Construction Co., San Francisco; A. Wells, president of the John Griffiths & Sons Construction Co.; A. N. Carter, manager of the Highway Division of AGC, Washington, D.C., and co-secretary to the committee; and Duane Cronk, associate editor of *The Constructor*.

Pictured at meeting of ASCE-AGC Joint Cooperative Committee (reading clockwise, top photo) are C. E. Beam, representing ASCE; Arthur Wells, AGC; Dwight W. Winkelman, AGC; Past-President Gail A. Hathaway, ASCE; A. N. Carter, AGC; Augustine Ayres, ASCE; and Maurice Quade, ASCE. Lower view shows ASCE Executive Secretary William N. Carey (left) with Allan S. Quartermaine, president, Institution of Civil Engineers (Great Britain); Graham Clark, secretary, Institution of Civil Engineers; and J. B. Stirling, president, Engineering Institute of Canada.

EMC Sponsors Manpower Utilization Conference During ASCE Centennial Convocation Program

The role of effective manpower utilization in the universal obligation of each citizen to serve his country was discussed in an all-day conference held in Chicago on September 5 under sponsorship of the Engineering Manpower Commission of Engineers Joint Council. Chairman of the conference, which was a feature of the Centennial Convocation program, was Carey H. Brown, manager of engineering and manufacturing services of the Eastman Kodak Company.

In the interest of national security, the conference recommended that:

1. All segments of our economy follow implicitly the principles delineated in the National Manpower Mobilization Policy promulgated by the President on January 17, 1951.

2. In the development of programs and plans for national security more consideration be given to the value of building the productive potential and coordination be effected between production and our manpower needs. Adequate productive facilities are far more important to the successful defense of the nation than is the build-up of military forces during times of peace or partial mobilization.

3. A practical plan for Universal Military Training be developed and enacted into law. Provisions should be included to reduce our standing Armed Forces as early as practicable so that the training of our young men and the creation of a continuing reserve through UMT can be commenced.

4. Plans for Universal Military Service as presently proposed be abandoned as unsound and prejudicial to the national security.

5. The Selective Service System be strengthened to provide advisory service to local and state boards with respect to professional and specialized persons.

6. Selective Service regulations be modified so that college students in engineering, science, and other critical fields can be given the assurance of being able to complete their education before being inducted, as in the case with those now enrolled in ROTC programs.

7. The Armed Forces Reserve Act of 1952 be amended to provide for the creation of a Civilian Reserve Governing Board, outside the military departments, to establish criteria for, and render final decisions with respect to, the classification and mobilization assignment of reservists having specialized skills and experience and to maintain a continuing process of classification of reservists with such skills.

8. The Armed Forces Reserve Act of 1952 be amended to provide for the creation of local and state civilian reserve boards operating under the civilian reserve governing board to render decisions at the local level with respect to the classification, mobilization assignment, and delay in recall to active duty of reservists within the framework of the criteria established by the Civilian Reserve Governing Board.

9. The Armed Forces Reserve Act of 1952 be amended to provide for the continued training of professional and scientific personnel without interruption.

10. The present trend in ROTC units toward providing only branch general training and discontinuing technical curricula be reexamined in the light of its effect on utilization of those with special and critical skills.

11. New criteria be established for choosing students for ROTC programs to insure distribution of graduates between military and civilian agencies on a basis that will better satisfy national needs.

12. Realistic quotas be established for the various ROTC programs and entrants be restricted within these quotas and in accordance with needs for their fields of specialized training.

Attending meeting of ASCE Division Activities Committee during Convocation are (upper left photo, reading clockwise), Vice-President D. V. Terrell, chairman; George R. Schneider, Little Rock, Ark.; Frank A. Marston, Boston, Mass.; Jewel M. Garrelts, and Vice-President George Burpee, New York, N.Y.; and Philip C. Rutledge, Evanston, Ill. Below, Mrs. Howard Peckworth, (far right), chairman of Ladies Centennial Committee, and the Misses Alice and Peggy Peckworth preside at daily Coffee Hour. With them are Mrs. Walter Huber (far left) of San Francisco, and Mrs. C. A. Arenander, of New York.

Irrigation and Drainage Commission Formed in U.S.

Membership of the United States in the International Commission on Irrigation and Drainage, sponsored by the Executive Committee of the ASCE Irrigation and Drainage Division, was approved by the Commission at its meeting in Chicago on September 8 during the Centennial Convocation. About 30 members of the U.S. interim committee then met on September 9 to effect final organization of the U.S. National Committee. A constitution was adopted and the following executive committee elected: W. E. Blomgren, Denver, Colo., chairman; G. T. McCarthy, New York, N.Y.; A. P. Rollins, Austin, Tex.; Ivan D. Wood, Denver, Colo.; S. D. Gross, Middletown, Ohio; Harold A. Scott, Jacksonville, Fla.; and Harold Conkling, Los Angeles, Calif. The new U.S. Committee will be a non-governmental, privately financed body, widely representative of irrigation and drainage.

Seventeen countries were represented at the meeting of the International Commission. Sir William Halcrow, of England, presided in the absence of the president, A. N. Khosla, M. ASCE, of Delhi, India. The next meeting of the International Commission will be in Algiers, Africa, in April 1954.

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13. All segments of our economy take specific steps toward full utilization of persons possessing critical and specialized skills in short supply in the best interest of the country as a whole rather than in their special interest. To this end, it is important that budgets of specialized manpower needs be established, and that the duties performed by specialized persons be thoroughly studied in order to reallocate them to the maximum possible extent to less highly skilled persons.

U.S. Committee on Large Dams Meets in Chicago

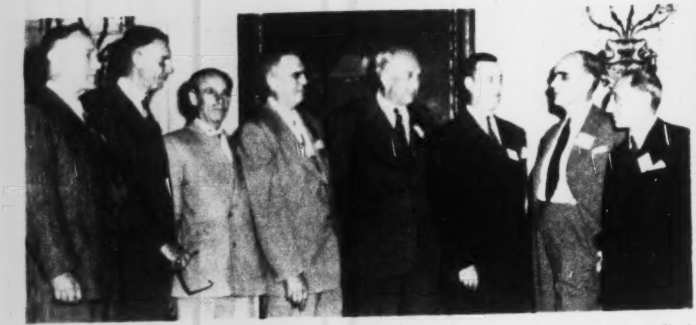
The United States Committee of the International Commission on Large Dams met in Chicago on September 5, following the meeting there of the Executive Committee of the International Commission. The most urgent business before the meeting was to arrange for adequate financing of committee affairs so as to make it independent of contributions from non-member organizations. It was decided that no change would be made in the prevailing policy of limiting membership in the committee to a relatively small number of highly qualified engineers and other specialists and organizations of exceptional accomplishment in the field of design and construction of large dams. Annual dues to finance the committee's activities were fixed at $10 for individuals and $100 for organizations.

To ensure a membership of high professional standing, a membership committee was appointed under the chairmanship of L. N. McClellan, chief engineer of the Bureau of Reclamation, Denver, Colo. Other prominent engineers who agreed to serve on the committee are C. E. Blee, S. B. Morris, F. B. Slichter, and W. F. Uhl. It will be the task of the committee to recommend individuals and organizations for membership. Interested persons should get in touch with Mr. McClellan or the Committee Chairman, Carl P. Vetter, M. ASCE, chief, Office of River Control, Bureau of Reclamation, Boulder City, Nev.

Engineering Study Team from Abroad Visits N. Y.

Visiting the United States for the Centennial of Engineering celebration, some 180 engineers from Marshall Plan countries were guests at a recent cocktail party and reception given by New York engineers as a gesture of welcome to the United States. The group included six engineers from Southeast Asia. After a four day seminar, the engineering visitors went to Chicago for the Centennial celebration, and from there are touring the country in groups according to their fields of interest.

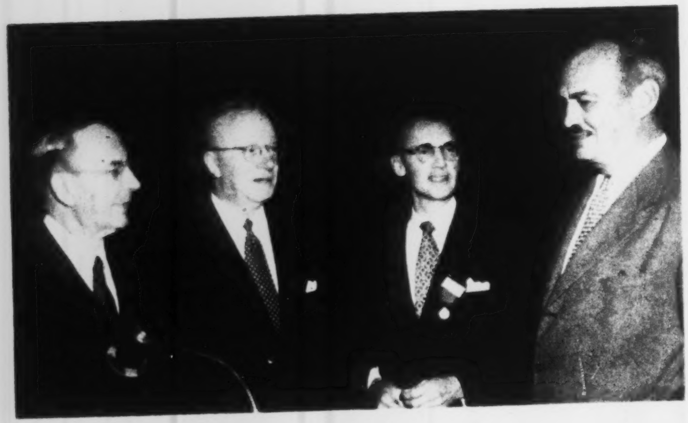
Hosts for the New York party were the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the American Institute of Chemical Engineers, the Moles, the Institute of Radio Engineers, and the New York State Society of Professional Engineers. The tour is being conducted by the National Management Council, under the auspices of the Mutual Security Agency.



Foreign engineers visiting United States under MSA sponsorship are welcomed by New York engineers at cocktail party and reception at Roosevelt. Shown left to right are: Trygvie Hodne, Oslo, Norway; Johan Schlingemann, The Hague, Netherlands; Giuseppi Chisini, Rome, Italy; W. N. Carey, Executive Secretary, ASCE; Richard E. Dougherty, Past-President, ASCE, and chairman of Reception Committee; Thomas J. Wilson, chief of Industrial Branch, Technical Assistance Division, Mutual Security Agency; Alexander Kalinski, Athens, Greece; and Joaquim C. F. Alvarez, Lisbon, Portugal.

AMERICAN SOCIETY OF CIVIL ENGINEERS

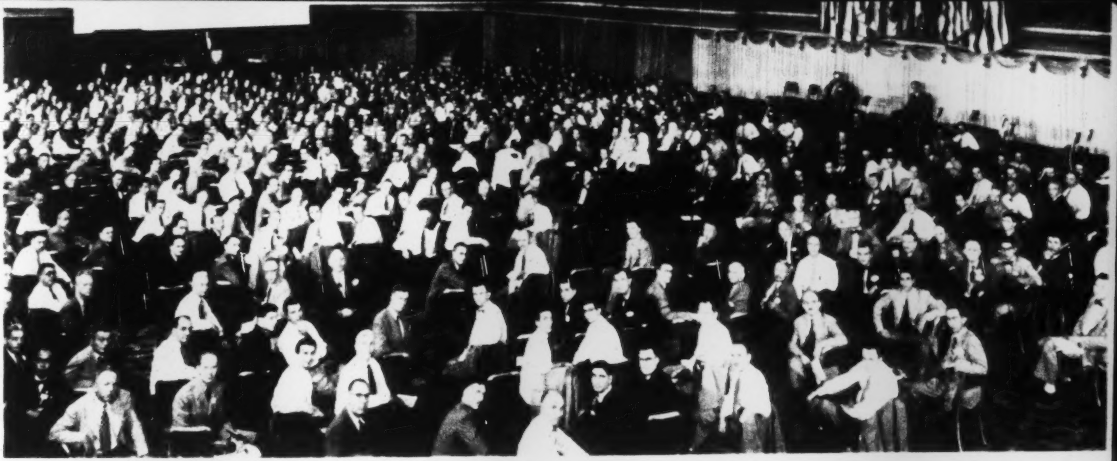
ASCE Honorary Member Karl Terzaghi (above) opens Soil Mechanics and Foundations Division program before audience of more than 400 during Centennial of Engineering Convocation. World-famed authority on soil mechanics, Dr. Terzaghi has lectured and taught both here and abroad and currently is professor of civil engineering at Harvard University.



Group at left plays leading part in presentation of interesting Symposium on Structures and Construction—one of twelve especially arranged for general public during Convocation program. Use of such devices as sound track and back-drop of pictures of beautiful structures added to effectiveness of program. Shown, in usual order, are D. B. Steinman, New York City consultant and international bridge authority; Willard T. Chevalier, executive vice-president, McGraw-Hill Publishing Co., New York; Waldo G. Bowman, chairman of symposium program and editor of "Engineering News-Record", and John O. Merrill, Chicago architect.

ASCE
MEXICO SECTION
UNIVERSITY CITY OF MEXICO PROJECT IS 70% COMPLETED
COST TO DATE

Appreciative group examines impressive exhibit set up in Conrad Hilton during Convocation period by Mexico Section of ASCE (photo at left). Display includes model of huge project being built by University City of Mexico as part of its expansion program. In foreground are ASCE Past-President J. C. Stevens, Portland, Oreg.; Pedro Albin, Mexico City; F. J. Serrano, president of Mexico Section; A. M. Valdes, Mexico City; D. P. Reynolds, Assistant to Secretary of ASCE, New York; Alex L. deLarrea; and F. J. Serrano, Jr., Mexico City.



Record-Breaking Crowds Jam Convocation Sessions on Prestressed Concrete

Prestressed concrete and thin shell roof construction proved record breaking drawing cards at the Centennial Convocation. Interest in the growing use of these types of construction in the United States brought nearly 900 engineers (shown above) to the grand ballroom of the Conrad Hilton Hotel to attend two joint sessions conducted by the Structural Division of the ASCE and the American Concrete Institute. Programs for these sessions were arranged by C. E. Wuerpel, M. ASCE.

A major reason for the large attendance at these sessions on prestressed concrete was given in the opening report by M. J. Holley, A.M. ASCE, associate professor of structural engineering at Massachusetts Institute of Technology, who pointed out that the use of prestressed concrete in this country in the past year has increased tenfold.

"We have passed beyond the small projects . . . into the field of larger and more important utilization," Rear Admiral Joseph F. Jelley, chief of the Bureau of Yards and Docks, told the group at the end of the prestressed concrete session. He pointed to the Tampa Bay Bridge and New York Pier 57 as examples of such projects in this country, and said that he was impressed with indications that "prestressed concrete is becoming competitive with the older materials and methods of construction."

"Of particular interest to me," Admiral Jelley added, "is the fact that savings in steel, particularly structural steel, can be expected from the use of prestressed concrete. The saving of structural shapes has been particularly important during the past two years when the construction industry was operating under a system of priorities and allocations." The Bureau of Yards and Docks, he noted, has its largest building construction programs in times of emergency when critical material shortages must be anticipated, and he predicted that prestressed concrete will play an important role at such times.

He expressed satisfaction that three of the speakers on the joint program (Professor Holley, Prof. Nathan Newmark of the University of Illinois, and Curzon Dobell of Preload Enterprises, Inc.) recognized that we must look forward to advances in design "and not restrict the use of prestressing to simple beams."

Engineers attending the final joint session were treated to illustrated discussions of spectacular past, current and proposed thin-shell concrete roof construction here and abroad. So unusual were some of the projects described by Louis Corbetta, of the Corbetta Construction Co., who read the paper of Pier Luigi Nervi, of Rome, Italy, that the crowd broke into exclamations of amazement.

Of particular interest were photographs of the 320-ft span Torino Exposition Hall; Dr. Nervi's "birdlike cage" hangar, built in the early forties on the shores of the Mediterranean; and the salon of the Bathing House of Chianciano, built in 1951. The latter structure showed imaginative use of precast, curved, undulated slabs with a span length of about 41 ft.

Mr. Corbetta stated that Dr. Nervi, after studying the procedure of architects Loretio & Marchi in designing a large hangar for the Buenos Aires Airport with a span of about 590 ft, felt the possibilities were almost limitless. "I tried to examine the limitations for this undulated structure," Dr. Nervi wrote, "and I came to the conclusion that it is possible without great cost to build an arch with a span of 300 metres (about 984 ft.)."

Highpoints of the session, however, were provided by Mr. Corbetta's own comments on the lag in such construction in this country. "When the advantages of new design in construction thinking are self-evident," he said, "let the architect-engineer come forward boldly with his design as a *base* bid . . . never mind the alternates. I feel that the contractors of America will respond to the challenge and in no time the new technique will be learned, and then competition will take care of the rest."

French Engineers Entertained in New York

French delegates to the Centennial of Engineering in Chicago, were entertained by Philip Cortney, president, French Engineers in the U. S., Inc., at an elaborate dinner at the Savoy Plaza in New York, on August 27. In addition to the delegation from overseas, the guests included ASCE Director Walter D. Binger, several members of the ASCE Headquarters staff, and Clarence E. Davies, Secretary of ASME.

Among the delegates was George Ville, secretary general of the Société des Ingenieurs Civils de France, which celebrated its centennial in 1949. One of the interesting events of the evening was the presentation to Secretary Ville of a certificate of membership in the ASME by Secretary Davies. A dynamic bilingual address by Mr. Cortney briefed the French delegation on what they could learn about the United States during their sojourn.

UPADI Adopts Constitution and Code of Ethics at New Orleans Convention

Cooperation among the engineers of the Western Hemisphere was further advanced by the second UPADI (Union Panamericana de Asociaciones de Ingenieros) Convention held on the Tulane University campus in New Orleans, La., August 25 to 29. Engineers Joint Council and the Engineering Institute of Canada were co-hosts to the convention, which was attended by 314 engineering delegates from all but a few of the North, Central, and South American nations. At the conclusion of the program, more than 200 South American engineers went on to Chicago for the ASCE Centennial celebration.

The local organizing committee was under the direction of James M. Todd, past president of ASME and chairman of the U. S. delegation. Carlton S. Proctor, President of ASCE and an EJC delegate, was appointed chairman of the convention and ably conducted the sessions. Work in committees and during the plenary sessions was carried on in three languages: English, Spanish and Portuguese.

Ever since the organizing convention of UPADI, held in Havana, Cuba, in April 1951, several committees have been developing a constitution, a code of ethics, a plan for relation with other bodies, and a pattern for future programs. After exhaustive work by all of these committees, made more difficult by language differences, their reports were approved by the convention. The convention decided to hold the next UPADI meeting in São Paulo, Brazil, in 1954 (probably September), when the city will be observing the four hundredth anniversary of its founding.

A highlight of the program was the presentation by UPADI President Luis Giannattasio, of Uruguay, of a bronze plaque commemorating the New Orleans Convention to Mr. Proctor, who accepted it in behalf of EJC. The Engineering Institute of Canada presented plaques bearing the coat of arms of Canada to each of the delegations present.

UPADI officers, in addition to Dr. Giannattasio, are Manuel J. Puente (Cuba), first vice-president; Saturnino de Brito, filho (Brazil), second vice-president; and S. E. Reimel (United States), Rodolfo Ballester (Argentina), Juan V. Cabrerizo (Peru), Hector Cassaigne (Mexico), and J. B. Stirling (Canada), secretaries.

Mayor de Lesseps Morrison (far right) of New Orleans welcomes UPADI group at opening-day luncheon. Shown with him (reading left to right) are Manuel J. Puente, president of Sociedad Cubana de Ingenieros, Cuba; Fred Cole, dean of Tulane University; T. G. LeClair, president of EJC; and Luis Giannattasio, president of UPADI.

Hathaway Elected President Commission on Large Dams

At the meeting of the Executive Committee of the International Commission on Large Dams, in Chicago on September 5, Gail Hathaway, Past-President of ASCE, was elected president for the ensuing term of three years, succeeding Andre Coyne, Hon. M. ASCE. Mr. Hathaway is succeeded as chairman of the United States Committee on Large Dams by Carl P. Vetter, M. ASCE, U. S. Bureau of Reclamation, Boulder City, Nev. Mr. Hathaway has also been elected vice-president of the World Power Conference.

Paris, France, was selected as the meeting place of the next session of the Commission which is scheduled for 1955. The United States Committee issued an invitation for the 1958 meeting.

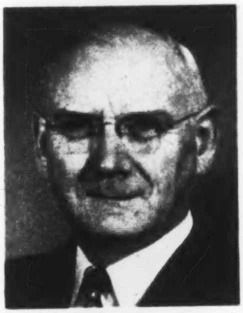
Annual Business Meeting Scheduled for October 15

The 1952 annual business meeting of ASCE is to be held at 3 p.m. on October 15, in the Conference Room of the Statler Hotel in New York. As required by the Constitution, the meeting is scheduled for the third Wednesday of the month, to provide an opportunity for the transaction of business. The order of business, as provided in the By-laws, will consist of reports of the Board, the Secretary and Treasurer, the report of the tellers on the canvass of ballots for officers, installation of the newly elected officers, and new business.

Since there will be no ASCE Convention in New York this October, the Metropolitan Section is arranging a dinner meeting for the evening. To facilitate attendance at both the business meeting and the dinner, both functions will take place at the Statler. A cocktail lounge will be provided for the convenience of members attending both functions. The dinner program, which is set for 6:30, will feature the inaugural address of the newly installed President, Walter L. Huber.

Franklin Thomas, Former President of ASCE, Dies

Word of the death of ASCE Past President Franklin Thomas in Pasadena, Calif., on August 27 will come as a shock to his many friends who had thought he was recovering from a serious operation. He was 67. Dean of students and professor of civil engineering at California Institute of Technology at the time of his death, Dean Thomas had been on the Caltech staff since 1912, when he went to the Institute as associate professor of civil engineering to develop the department.


Franklin Thomas, 1885 1952

An authority on water supply, irrigation hydraulics and silt deposits, Dean Thomas had been called the person most responsible for obtaining Colorado River water for Southern California. He had been a member of the board of directors of the Metropolitan Water District of Southern California since its organization in 1928, and was vice chairman of the board from 1929 to 1947. He also served as consultant on flood control and sanitation projects for the City of Los Angeles and for Los Angeles and Orange counties.

Cited "a great civic leader," Dean Thomas received the Arthur Noble Medal for distinguished service to the City of Pasadena in 1939. In the Society, which he joined as a Junior in 1912, he served as a Director from District 11, Vice President from Zone IV, and President. He had also been chairman of the Committee on Accredited Schools and a member of the Committee on Irrigation Hydraulics, and president of the Los Angeles Section.

Tellers Canvass Ballot for 1953 ASCE Officers

September 16, 1952

To the 1952 Annual Meeting
American Society of Civil Engineers:

The Tellers appointed to count the Election Ballots for Officers of the Society for 1953 report as follows:

For President

(Term October 1952 October 1953)

Walter Leroy Huber	9,890*
Scattering	9
Void	16

For Vice President Zone II

(Term October 1952 October 1954)

Edmund Friedman	1,956
Scattering	6
Void	15

For Vice President Zone III

(Term October 1952 October 1954)

Charles H. Mottier	1,343
G. Brooks Earnest	1,883
Scattering	5
Void	46

For Director District 1

(Term October 1952 October 1955)

Charles B. Molineaux	961
Scattering	5
Void	7

For Director District 3

(Term January 1953 October 1955)

A. A. K. Booth	389
Scattering	0
Void	4

For Director District 5

(Term January 1953 October 1955)

Carl G. Paulsen	358
Scattering	0
Void	3

For Director District 7

(Term January 1953 October 1955)

Lloyd D. Knapp	619
Scattering	1
Void	4

For Director District 9

(Term January 1953 October 1954)

Warren Wright Parks	419
Don Melvin Corbett	407
Scattering	0
Void	2

For Director District 11

(Term October 1952 October 1955)

Mercel J. Shelton	1,615
Scattering	0
Void	3

For Director District 12

(Term January 1953 October 1955)

Glenn W. Holcomb	606
Scattering	0
Void	4

For Director District 16

(Term January 1953 October 1955)

Earl L. Mosley	444
Francis M. Dawson	446
Scattering	0
Void	4

Ballots counted	21,470*
Ballot envelopes rejected Without signature	72

Respectfully submitted

Paul M. Wentworth, *Chairman*
Arthur R. Luecker, *Acting Vice Chairman*
Egidio O. DiGenova Simeon Chanley
Frederick W. Ockert Edward S. Jarosz
Alex J. Castro Milton C. Shedd
Charles H. Clarahan, Jr. Robert Warshaw
(*Tellers*)

* *Editor's Note*

1. Every member of the Society eligible to vote received a ballot for election of a President.
2. Members in Zones II and III also received ballots for election of a Vice-President to represent the members in these Zones.
3. Members in Districts 1, 3, 5, 7, 9, 11, 12, and 16 also received ballots for election of a Director to represent the members in these Districts.
4. The total of all these ballots received equals the total ballots counted.

Films on Engineering Mechanics Made Available

A new list of motion pictures in the field of fluid mechanics and hydraulics has been prepared under the auspices of the Fluid Dynamics Committee of the ASCE Engineering Mechanics Division. The new listing supplements that prepared in 1948 by Prof. Vito A. Vanoni, M. ASCE, and includes data on 79 films from twelve different organizations issued since then. It is compiled by Walter L. Moore, A.M. ASCE, associate professor of civil engineering at the University of Texas, Austin, Tex.

Copies may be obtained from ASCE Headquarters, 33 West 39th Street, New York 18, N.Y., or from Professor Moore

Scheduled ASCE Conventions

SAN FRANCISCO CONVENTION

San Francisco, Calif., March 2-7,
1953

MIAMI BEACH CONVENTION

Casa Blanca Hotel
June 17-19,
1953

NEW YORK CONVENTION

Hotel Statler
October 19-23
1953

Coming Events

Central Ohio A report of members attending the Centennial of Engineering will be presented at a meeting on October 16.

Cleveland Dinner meeting at the Cleveland Engineering Society, Cleveland, Ohio, on October 17, at 6:30 p.m.

Cincinnati Regular meetings will be held on the first Wednesday of each month, beginning October 1.

Duluth Meetings are held the third Monday of every month at the Kitchi Gammi Club in Duluth.

Ithaca The October meeting is scheduled for October 23, at Ithaca.

Kansas Meeting at Salina, Kans., on October 17.

Maryland Dinner meeting at the Engineers Club of Baltimore on October 8, at 7 p.m., preceded by cocktail hour at 6 p.m.

Nebraska Meeting at Grand Island on October 17.

Sacramento Weekly luncheons at the Elks Temple, Sacramento, every Tuesday at 12 noon.

San Francisco Weekly luncheons at the Engineers' Club of San Francisco every Wednesday. Dinner meeting October 21.

Texas Fort Worth Branch will be host to the Texas Section, for its three-day fall meeting to be held from October 16 to 18. Headquarters will be the Texas Hotel, Fort Worth.

ASCE MEMBERSHIP AS OF SEPTEMBER 9, 1952

Members	8,255
Associate Members	10,474
Junior Members	16,719
Affiliates	68
Honorary Members	42
Total	35,558
(September 7, 1951	35,251)

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Brazil	August 8	38	Dinner meeting. Life' membership certificate awarded to W. L. Zeigler. Paul L. Heslop, president of section spoke about the Peixoto Project of Cia.
Cincinnati	August 15	22	Cincinnati Section was host to the third annual meeting of the District 9 Council.
Florida	August 11	...	Family picnic held at Cuitan Park.
Northwestern Subsection	September 8	20	G. F. Bailey and E. P. H. Willet of the A. W. Williams Inspection Co., were guest speakers for the evening.
Los Angeles	August 27	111	An illustrated talk on "Freeway Development" was presented by Paul Harding, assistant state highway engineer, in charge of District 7.
Maine	August 7	75	Second anniversary meeting addressed by George Burpee, Vice-President of Zone I, and Carlton S. Proctor, ASCE President.
	August 16	130	Joint meeting with the Maine Association of Engineers. Inspection of Great Northern Paper Co. construction project at Ripogenus Dam followed by supper. Roy V. Weldon, vice-president, division of engineering, Great Northern Paper Co., described the project.
Mexico	August 12	46	Joint meeting with Mexican section of ASME and AIEE. Centennial of Engineering was discussed by members.
Nebraska	September 10	67	H. H. Nicholson, chief of supervision and inspection branch, construction division, Omaha District, Corps of Engineers, presented a movie showing construction of Fort Peck Dam.
Texas Dallas	September 8	...	Newly elected officers include: W. Scott McDonald, president; C. H. Meers, vice-president; and L. A. Langford, secretary-treasurer.
Tri-City	September 16	21	Smoker. Talk on sedimentation program by the Corps of Engineers was given by J. B. Saylor, engineer for the Rock Island District.

Kentucky Section entertains ASCE officers at recent meetings in Lexington and Louisville in observance of ASCE Centennial of Engineering. Attending luncheon in Lexington are (left to right) G. Brooks Earnest, of Cleveland, Ohio, Director for District 9; President Carlton S. Proctor, of New York; D. V. Terrell, of Lexington, Ky., Vice-President for Zone III; and J. Stephen Watkins, Lexington consultant and host to the group. Program was shifted to Louisville for evening dinner meeting, which featured address by President Proctor. Attendance was about 150. At conclusion of program, President Proctor received souvenir gifts from University of Louisville and University of Kentucky Student Chapters, and Kentucky colonelcy from D. H. Bray, state highway engineer representing the governor.

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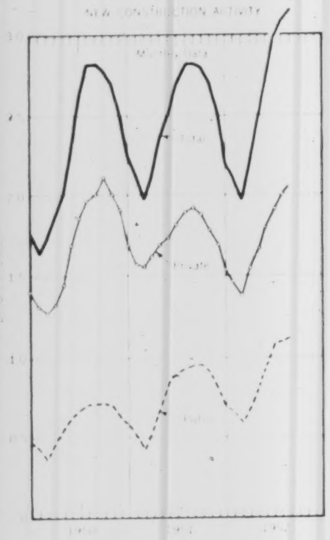
NEWS BRIEFS . . .

Construction Activity in August Continues to Climb

Expenditures for new construction in August rose seasonally (by 2 percent) to $3,152 million, the highest monthly figure on record, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the U.S. Department of Commerce. Special investigation into contract construction employment and the field operations of major public construction agencies reveal that the steel strike had no demonstrable effect on construction expenditures for the month, the joint agencies note.



Seasonal rise of 2 percent in construction for August to $3,152 million, highest monthly figure on record, is shown in Department of Commerce curves.

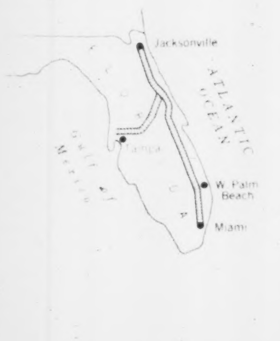
A slow but steady decline has occurred in private industrial building during the past few months, although other major types of private and public construction have, by and large, shown the usual seasonal advances. Private new construction activity as a whole stood at $2,042 million this August, and public at $1,110 million. New homebuilding activity constituted the largest part of private volume and alone accounted for 46 percent of the private total. Public construction for defense—chiefly work on atomic energy and military and naval facilities—accounted for 30 percent of the public sector. Another 30 percent of public outlays went for highway work.

In a comparison of dollar volume for the first eight months of this year and last, public construction gained by over a fifth, as major advances occurred in building atomic energy and military and naval facilities. Private construction lagged slightly over the year, because greater outlays for private plant and public utility construction did not offset the drop in commercial and certain other types of nonresidential building and in housing. However, the gap between 1952 and 1951 outlays for new housing is now fairly narrow, reflecting the continuous high level of home construction during the spring and summer months of 1952.

Jacksonville-to-Miami Toll Road Recommended

Construction and operation of a 350-mile limited-access turnpike from Jacksonville to Miami, Fla., with a 128-mile westward branch across the state to Clearwater, is recommended by the New York engineering firm of Parsons, Brinckerhoff, Hall & Macdonald, following a recent survey made for the Florida State Road Department. The estimated cost of the project is $275,000,000, to be financed by revenue bonds and amortized by collection of tolls. A toll rate of 1¼ cents a mile for passenger cars and light trucks, and of 2 to 7 cents a mile for heavy trucks, depending on weight, is recommended in the report.

Located to the west of and paralleling U.S. 1, the proposed east-coast route would begin at Jacksonville, where it would connect with the $50,000,000 Jacksonville expressway system now under construction, and extend south to Miami. There would be no traffic lights on the entire 315-mile superhighway. Sixteen traffic interchanges would let traffic on and off the turnpike. Proposed locations for these interchanges are Bayard, St. Augustine, Bunnell, Daytona Beach, New Smyrna Beach, Titusville, Cocoa, Melbourne, Vero Beach, Fort Pierce, Stuart, West Palm Beach, Delray Beach, Pompano Beach, Fort Lauderdale and Miami.



Emphasizing the fact that Florida highways have not kept pace with the tremendous increase in tourist traffic, the engineers' report urges immediate construction of a turnpike. It points out that, though such a road will not solve all the state's highway needs, "The toll road principle offers the most sensible and realistic approach to one of Florida's pressing highways problems." The principal highway deficiencies were found to be the inadequacy of the state's east-coast route and of highways in the central part of the state from Daytona Beach to Tampa Bay. Calling limitation of access the most essential feature in any plan for improvement, the report notes that "The cost of widening and otherwise improving the existing roads through these areas, combined with the necessary limited-access features, would be prohibitive even if it were desirable."

The engineering report was considered at a recent meeting of the State Road Department, which then referred it to Gov. Fuller Warren and the State Improvement Commission for further consideration. The latter organization, which would handle issuance of revenue bonds for the project, will make an independent survey to determine whether or not the project is economically feasible.

The four-lane turnpike project has been the subject of considerable controversy since it was first proposed last year by the State Road Department and Governor Warren.

Contract Awarded for VA Hospital in Los Angeles

Award of a general construction contract for the 1,000-bed neuropsychiatric hospital, to be built by the Veterans Administration in Los Angeles, Calif., to the Gust K. Newberg Construction Co., of Chicago, is announced by the VA. The contract will include construction of 25 structures and connecting corridors, roads and walks; fencing, grading and drainage; mechanical work; outside distribution systems; and the razing and removal of certain existing buildings. The bid was $17,912,000.

Indian Power Plant Nears Completion

The huge Bokaro Thermal Power Plant on the Damodar River in India is nearing completion, according to the Kuljian Corp., of Philadelphia, engineers and builders of the $35,000,000 project. The first boiler was erected in February, and the first turbogenerator unit will be placed in operation this December. When completed, the four-unit station will have a capacity of 240,000 kw. An earth fill dam is being built in connection with the station to provide a cooling reservoir. The project also includes construction of 477 miles of transmission lines with necessary substations and auxiliary equipment.

The first high-pressure steam-generating plant in the Far East, the Bokaro project is part of a vast power program being undertaken in India with the help of World Bank funds and technical "know-how" supplied by the United States.

Nashville Lets Contract For New Sewerage System

Construction of a new municipal sewerage system for the City of Nashville, Tenn., will begin in October, following recent award of a $10,000,000 contract to the Chicago architectural firm of Bertrand Goldberg Associates. The firm will coordinate engineering and design with financial management of construction on a single-fee basis, under the direction of C. A. Billings, M. ASCE, head of the firm's engineering division and former deputy project manager for the Paducah, Ky., plant of the AEC. The Nashville firm of Rice, Harwood & Clark will serve as local engineers on the work.

An initial project in the city's extensive public-improvement program, the new system will include eleven miles of sewer (seven to be tunneled through solid rock at a depth of 80 ft) and a disposal plant.

Large Aluminum Plant To Be Built in Alaska

Construction of a $400,000,000 aluminum smelting project will be started in Alaska by the Aluminum Company of America as soon as the necessary land can be purchased and government approvals obtained. Speaking recently at Mt. McKinley National Park, Leon E. Hickman, vice-president and general counsel for the company, outlined details of the project that would have an initial annual capacity of 200,000 tons.

Though the smelting facilities and necessary electric power developments would be situated in the Taiva Valley district near Skagway, Alaska, the water power required for operation of the hydroelectric plant would have to come from Canadian sources, Mr. Hickman said. Thus the consent of Canadian government agencies for use of the water must be obtained. Tentative plans call for damming the Yukon River at Miles Canyon, near Whitehorse, and installing generating capacity sufficient to supply the requirements of the Whitehorse community and the surrounding area, including part of the Yukon Territory. Water from the reservoir formed would be carried under the Rocky Mountains through two tunnels, with a combined length of 21 miles, to two power houses in the Taiva Valley area at tidewater.

Calling the Taiva development a great step forward in the industrial development of Alaska, Mr. Hickman estimated that the project will afford employment for about 4,000 persons when full-scale operation is under way. Completion of construction will require about four years.

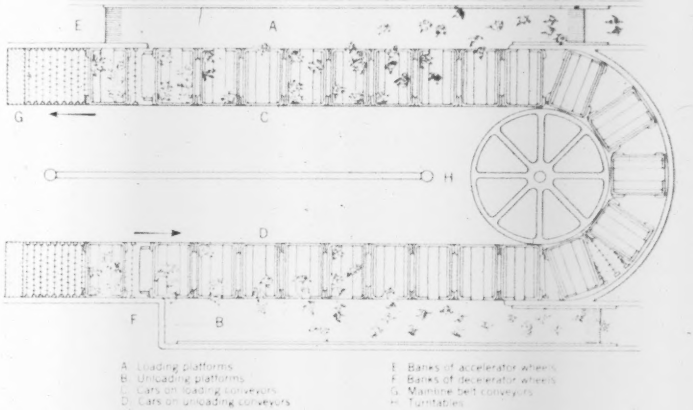
Moving Platform to Replace Grand Central Shuttle Asked

Recent proposals of the New York City Board of Transportation for installation of a moving platform to replace the subway shuttle between Times Square and Grand Central Terminal call for a completely new method in subway transportation, based upon the conveyor belt. The plan, which is now before the City Planning Commission, entails the use of moving loading and unloading platforms and small closely spaced passenger cars riding on an endless track of rubber conveyor belts. Passengers at either end of the shuttle would walk directly onto the loading platform, a 6-ft-wide moving belt. Alongside the loading platform, and moving at the same speed there would be a continuous stream of small passenger cars. Twenty-five cars, each seating ten passengers, would pass the loading platform every minute, and capacity could be increased by using larger cars and speeding up the rate of flow.

The moving platforms would operate at the maximum safety speed of 1½ mph (about half the average walking pace), and with the cars moving at the same speed alongside, the effect would be the same as if both were standing still and passengers were entering a car with seats on one side of the aisle. When the loaded cars reach the end of the platform, the doors would close automatically. The cars would then pass over banks of accelerator rubber-tired wheels onto the main conveyor belts which would speed up to 15 mph. At the other end of the line, the cars would be slowed down by similar banks of wheels onto belts moving at the speed of the unloading platform—1½ mph, as in the case of the loading platforms.

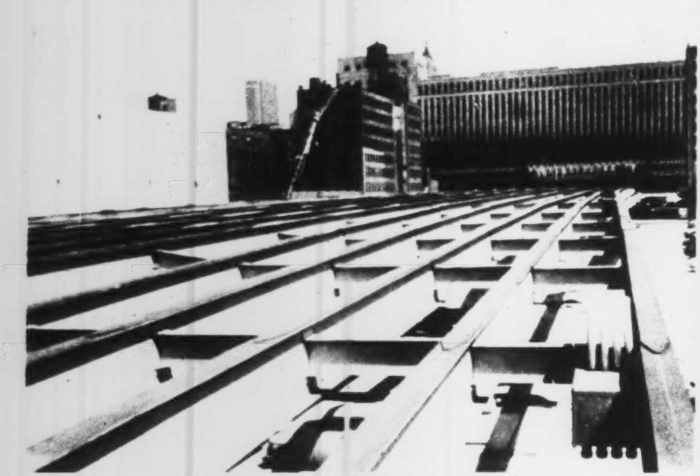
A major advantage of the proposed belt conveyor is that it would provide much greater capacity (15,000 passengers an hour) than the present shuttle, eliminating platform congestion and crowding during rush hours. Installation costs would be reasonable—$2,100,000 in comparison with the $3,500,000 required for inadequate improvement of the existing system—and operating and maintenance costs would be greatly reduced. No basic improvements have been made in the present shuttle system since its installation in 1918 as a "temporary" expedient, despite the tremendous increase in the number of passengers using the service.

Engineering details of the project have been worked out by the Goodyear Tire and Rubber Company and the Stephens-Adamson Manufacturing Company, Aurora, Ill.


E
A
G
C
H
D
F
B
A. Loading platforms
B. Unloading platforms
C. Cars on loading conveyors
D. Cars on unloading conveyors
E. Banks of accelerator wheels
F. Banks of decelerator wheels
G. Mainline belt conveyors
H. Turntables

Overhead view of conveyor subway system, indicating arrangement of loading and unloading platforms and wheel for turning cars around on endless track, is shown in artist's sketch.

Chicago Pushes Work on Congress Street Superhighway



Progress on the new $135,000,000 Congress Street Superhighway in Chicago is indicated in this view, looking east toward the U. S. Post Office on the west side of the Chicago River. The elevated roadway, supported by steel girders, leads to the postoffice arcade as shown here and will pass through the building. Designed to ease Chicago's traffic problem, the project begins at Lake Shore Drive near Lake Michigan and will extend eight miles to the Cook County line. It will carry eight traffic lanes, including double tracks for subway transportation in Loop area. Completion of project is expected in 1955. Wide World photo.

Public Works Problems Studied at APWA Congress

More than 1,000 public works officials from all over the United States and Canada met in Los Angeles, August 24 through 27, for the 58th annual congress of the American Public Works Association. An equipment show, staged by more than 70 manufacturers, supplemented the program of twelve informal round-table discussions and three general technical sessions. The "What's Your Question" tables dealt with topics ranging from parking to refuse collection and disposal.

A symposium on "Action on the Pollution Abatement Front," with A. M. Rawn, Vice-President of ASCE and general manager of the Los Angeles County Sanitation Districts, acting as moderator, opened the technical sessions. Participating in the panel and discussing the problem from a three-way point of view—federal, interstate and state—were Carl E. Schwob, chief of the Division of Water Pollution Control, U. S. Public Health Service, Washington, D.C.; Edward J. Cleary, M. ASCE, executive director and chief engineer of the Ohio River Valley Water Sanitation Commission, Cincinnati; and Vinton Bacon, A.M. ASCE, executive director of the California Pollution Control Board, Sacramento.

Another general session featured a symposium on "Subdivision Controls," moderated by Charles B. Bennett, director of the Los Angeles Department of Planning. Included were papers on "Improvement Financing," by L. G. Apperson, city engineer of Portland, Oreg.; "Improvement Standards," by Harry Shatto, A.M. ASCE, director of public works, Hayward, Calif.; and "Planning Integration," by Andre M. Faure, planning director of Tucson, Ariz. The ever-present problem of public works financing was discussed in a third general session moderated by Samuel M. Roberts, director of finance for Long Beach, Calif. Participants discussing service charges, special assessments, general tax levies and borrowed funds included Myron W. Tatlock, M. ASCE, of Dayton, Ohio; Theodore D. Moss, director of public works and utilities of Flint, Mich.; John B. Massen, assistant to the city manager of San José, Calif.; and Stephen B. Robinson, Los Angeles attorney.

An address on "Cities' Interest in Water Resources" by Samuel B. Morris, M. ASCE, general manager and chief engineer of the Los Angeles Department of Water and Power, concluded the technical program.

Recognition was given Walter N. Frickstad, M. ASCE, district highway engineer for the State of California, for his long years of service to the APWA with election to honorary membership in the organization. Allan H. Rogers, superintendent of public works for Garden City, N.Y., succeeds Edward J. Cleary, M. ASCE, executive director and chief engineer of the Ohio River Valley Water Sanitation Commission, as president for next year. Other 1953 officers include Warren A. Coolidge, M. ASCE, director of public works for Nashville, Tenn., who was reelected vice-president for another two-year term, and Sol Ellenson, A.M. ASCE, director of public works for Newport News, Va., who will continue as director.

HHFA Grant Will Aid House-Building Techniques

To show builders and contractors new research developments in house planning and construction, two demonstration houses are being built by the University of Illinois' Small Homes Council in cooperation with the Division of Housing Research of the Housing and Home Finance Agency. Noting that in the past few years, "coordinated research in housing has resulted in many new recommendations regarding house design, construction techniques, and assembly methods and materials," James T. Lendrum, professor of architecture and director of the Small Homes Council, announces that the present project is designed to show contractors and craftsmen how to take full advantage of such time- and material-saving techniques.

Designed on the modular principle, the houses are adaptable to the open-room technique of construction—that is, roof trusses are being used so that the exterior walls can bear the load of the roof. Non-load-bearing partitions will be tipped into place after the floor, ceiling and wall finish materials are applied, permitting considerable saving of time and materials. The finish-materials can be applied without interruption by partitions and with a minimum of cutting and fitting of sheet materials, which are used wherever possible. Maximum flexibility of space use is assured by elimination of clear-cut separation of areas except for the bedrooms and bathroom.

City of Seattle Orders New Unit Substations

A $1,195,000 contract for sixteen 6,000-kva unit substations has been awarded to the Westinghouse Electric Corporation by the City of Seattle Department of Lighting. Addition of these substations, which will be used primarily to handle load growth in new residential areas, will make a total of 92 unit substations in the City of Seattle system. Eight of the new units will be put into service in 1953, the remainder in 1954.

Pump Motors Will Boost Colorado Aqueduct Capacity

A $1,277,000 order for four 12,500-hp pump motors has been awarded the Westinghouse Electric Corp., by the Metropolitan Water District of Southern California in its recently announced program to increase Colorado Aqueduct capacity by installation of ten large pumps (August issue, page 90). The vertical synchronous motors are for units four and five at the Eagle Mountain and Hayfield pumping stations of the Colorado River Aqueduct system. Rated at 6,900 v, three-phase, 60-cycle, the motors will be operated by electric power from Hoover and Parker dams. They are scheduled for delivery late in 1953.

Aluminum Output Continues to Gain

Production of primary aluminum in the United States in July reached 156,735,591 lb, exceeding the June output by nearly 2,000,000 lb, according to a release from Donald M. White, secretary of the Aluminum Association. This output "represents a gain over the same month last year of more than 11,000,000 lb, or about 8 percent," he said. Shipments of sheet and plated aluminum by member companies of the Association's Sheet Division totaled 85,049,202 lb in July—some 6,000,000 lb under shipments for the corresponding month of 1951.

Ground Broken for Third Tube of Lincoln Tunnel

Ground-breaking ceremonies for the recently authorized $85,000,000 Third Tube of the Lincoln Tunnel under the Hudson were conducted by the Port of New York Authority on September 25 at the site of the land shaft in 38th Street east of Twelfth Avenue. Participating in the ceremonies were Governors Thomas E. Dewey of New York and Alfred E. Driscoll of New Jersey, Mayor Vincent R. Impellitteri, and various state and local officials.

The first phase of construction, to be completed in 21 months, will go forward under a $2,546,925 contract awarded by the Port Authority on August 27 to the Gull Contracting Company, of Flushing, L.I. The land shaft, which will be 130 ft long, 60 ft wide and about 85 ft deep, will extend eastward from a point about 75 ft east of Twelfth Avenue. Used initially for delivery of materials into the river tube, the shaft will form the foundation for the New York ventilation building and will also contain a section of the tunnel roadway. To the east of the shaft, a 360-ft land section of the tunnel will be constructed under the first contract. It will be built by the open cut method and will require an excavation averaging 75 ft in depth and 35 ft in width.

Though the third tube was authorized by the Port Authority board in June 1951, start of construction was delayed over a year pending recent approval by the city of the plan of connections to metropolitan streets (July issue, page 76). The new two-lane tube will be operated in an eastbound direction, and the present north tube in a westbound direction; the middle or present south tube will carry traffic eastbound in the morning and westbound in the evening, or may operate one lane in each direction as required. Scheduled to be in operation in 1957, the project is expected to increase by 50 percent the annual capacity of the Lincoln Tunnel.

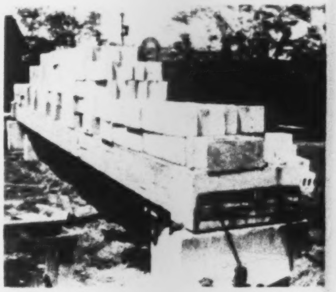
New System for Prestressing Beams Devised

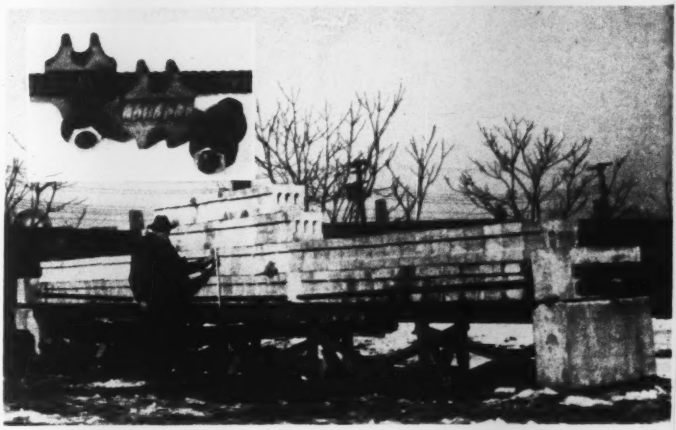
A system using deformed reinforcing bars to prestress a 31 ft 4 in. beam composed of common concrete blocks was recently set up in New York by L. Coff, M. ASCE, and subjected to load tests. The bars of 126,400-psi ultimate strength contrary to common practice were placed outside the block and subsequently grouted into position. The clamps were simple two-bolt, cast steel deformed to the shape of standard high-bond reinforcing bars. The stress in the two 1-in.-dia bars was 90,000 psi, and the strain 0.0036 in. per in. The concrete block tested to 3,540 psi in 30 days.

When loaded with 86-lb concrete blocks to the equivalent of an H-15 loading, the maximum deflection was 0.33 in. With a loading equivalent to dead load plus twice the live load, the maximum deflection was 0.85 in. No cracks appeared in the beams up to this load. With this load in place, the span length was reduced to 25 ft and the end clamps were removed. This increased the deflection by 0.2 in., but no cracks appeared except at one end where the beam was bearing against the unclamped end-anchorage block. When the load was left for 48 hours, maximum deflection increased to 2 in.

The beam was eventually tested to failure by removing the load of concrete blocks and substituting iron castings over the middle 8 ft of the beam. The load at failure was between 22.4 and 24.48 kips.

Simple, two-bolt steel clamp (shown in inset below), developed by L. Coff, M. ASCE, is designed to hold 100,000 psi in standard high bond bars. Common 3,500-psi concrete blocks form 31-ft 4-in. beam when prestressed by two 1-in. deformed reinforcing bars (see photo below). Bars have yield strength of 108,000 psi. After beam has been prestressed, bars are grouted into member. In view at right, span length of beam was reduced from 31 ft 4 in. to 25 ft, and clamps were removed. Full test load (twice live load plus dead load) is carried by bond of two 1-in. bars with no cracks appearing. Deflection under these conditions after 48 hours was 2 in.





Gaseous Diffusion Plant to Be Built in Southern Ohio

Construction of a major gaseous diffusion plant for the production of Uranium 235 will get under way soon on a recently selected 6,000-acre site in Pike County, Ohio, according to an announcement from the U. S. Atomic Energy Commission. Part of a new program to speed up production of atomic weapons by from four and a half to five years, the plant will be financed by funds made available by Public Law No. 547 signed by the President in July. However, locations have been under study for many months. The availability of electric power and water were determining factors in site selection.

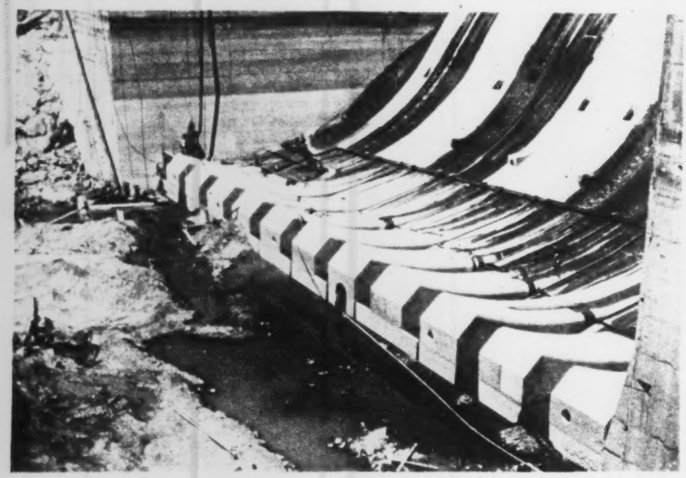
Acquisition of the site, which is about 60 miles south of Columbus and 22 miles north of Portsmouth, Ohio, will be handled for the AEC by the Army Corps of Engineers. The project will involve relocation of about 50 families and demolition of three towns—Van Meters, Wakefield and Sargents—with a total population of 300.

Preliminary design calls for a plant costing about $1,200,000,000 and requiring up to 400,000 kw of power—to be supplied from existing facilities for initial operation. New power plants will be built later to supply the maximum of 1,800,000 kw that will be needed when the entire plant is in operation. Although units of the plant will be placed in service as soon as they are completed, construction of the entire project is scheduled to take about four years. At the peak of construction some 30,000 workers will be employed.

Operation of the project, which is about the same size as the four other major atomic plants, will require a staff of from 4,000 to 5,000. In the gaseous-diffusion process, which is designed to separate fissionable Uranium 235 from non-fissionable Uranium 238, uranium hexafluoride in gaseous form is pumped through thousands of extremely fine barriers which have literally millions of tiny holes per square inch. Since U-235 atoms are slightly lighter and therefore travel slightly faster, they strike the screens and pass through the holes with greater frequency than do the U-238 atoms. This process gradually separates the U-235 atoms, a principal component of the atomic bomb.

Direct supervision of construction and operation will be under a new Portsmouth Area Office, to be established by the Oak Ridge Operations Office of the AEC. Kenneth A. Dunbar has been named area manager, and R. H. McCulloh deputy area manager. The principal construction contractor for the new plant is Peter Kiewit Sons' Company, of Omaha, Nebr. Concerns which will handle the various phases of design and architectural work include the Union Carbide and Carbon Corp., and Singmaster and Breyer, of New York City; Giffels and Vallet, Inc., and Smith, Hinchman and Grylls, Inc., of Detroit; Sargent and Lundy and Holabird and Root and Burgee of Chicago, and Burns and McDonnell of Kansas City, Mo. The Goodyear Tire & Rubber Co., of Akron, Ohio, has been appointed to operate the plant.

Construction Is Pushed on Davis Dam Spillway



Completion of Davis Dam spillway stilling basin is at hand under Bureau of Reclamation contract held by Grafe-Callahan Construction Company, of Dallas, Tex. Men and machines are excavating area below spillway to prepare it for concrete structure that will protect spillway from erosive action of high velocity water releases over spillway crest. Concrete extensions are dentates of spillway chute designed to break force of water discharged over spillway crest. Their huge size may be obtained by comparison with man (right center).

Placement System Set Up for Army Scientific Personnel

A successful two-day interviewing placement program for enlisted personnel assigned to Fort Monmouth, N. J., and classified as "scientific and professional" personnel, took place recently at the Signal Corps Engineering Laboratories there. With the approval of the Commanding General, Signal Corps Center at Fort Monmouth, a program to permit representatives of 17 major industrial corporations to interview enlisted technical personnel who will be discharged between now and January 31, 1953, was recently inaugurated.

Under the Army's Scientific and Professional Program, enlisted men with engineering and scientific degrees are given appropriate assignments after induction and basic training. More than 200 such personnel assigned to Fort Monmouth since the beginning of the Korean conflict took part in the interview program.

Improvements Slated for N. Y. International Airport

Recent award of contracts totaling $1,216,845 for improvement at New York International Airport is announced by the Port of New York Authority. The awards include a $1,162,338, contract for the superstructure of Hangar No. 6 to Wortman and Sons, Inc., of New York. Foundations for the 840 by 173-ft six-bay brick and steel structure, which will cost a total of about $3,000,000, are already under construction. Other awards, part of a $5,000,000 runway improvement program, provide five active runways.

Company Under New Owners

A change of ownership in the Lith-I-Bar Company, makers of concrete joist and concrete block machines, is announced. Mrs. Frank E. Milewski, widow of the founder, has sold her controlling interest in the firm, which is located in Holland, Mich., to O. W. Lowry and Charles R. Sligh, Jr.

Pennsylvania Turnpike Traffic Sets Record

Traffic and revenue on the Pennsylvania Turnpike reached an all-time high in August, according to the Pennsylvania Turnpike Commission. During this peak month, a total of 1,336,583 vehicles used the 327-mile superhighway across the state and paid tolls amounting to $2,232,720. Despite bad weather over the Labor Day weekend, which cut traffic to a minimum on most highways, a total of 257,812 vehicles used the turnpike and paid more than $406,000 in tolls—a 36 percent increase over the 1951 Labor Day weekend. On the basis of present traffic, this year's revenues are expected to be well over $20,000,000. Total revenues in 1951 were over $16,000,000.

West Virginia Plant to Have New Dock Facilities

A contract for construction of new harbor facilities at the Weirton, W. Va., plant of the Weirton Steel Co., has been awarded to the Contracting Division of the Dravo Corporation, Pittsburgh. A 400-ft-long loading dock, consisting of five 54-ft-dia connected circular steel sheetpile cells, will be constructed near the upstream end of the harbor. The project will also include one 30-ft-dia supporting cell, two 40-ft-dia ice breakers at the upstream end of the harbor, 14 barge-mooring cells 16 ft in dia, and four 40-ft dia cells to divert sewer flow and support a new two-track trestle leading to the dock.

Connecticut Extends Its Pollution Control Studies

First attempts to control pollution of Connecticut streams through investigation of an entire river valley rather than individual towns and industrial plants, are being made by the Connecticut State Water Commission with initiation of studies of the Quinnipiac River valley. The four communities located along the Quinnipiac, which are being studied for municipal sewage and industrial waste discharge, are Plainville, Meriden, Wallingford, and Southington. Following completion of a staff report on the valley pollution problem this fall, the Commission will make recommendations to the towns and industries concerned for an area-wide pollution abatement program.

New York Firm Awarded Thruway Bridge Contract

The award to the Merritt-Chapman & Scott Corp. of a $1,572,849 low-bid contract for construction of the foundation for ten easterly piers of the New York State Thruway Bridge across the Hudson River between Tarrytown and Nyack is announced by Bertram D. Tallamy, A.M. ASCE, chairman of the Thruway Authority. The ten piers will extend approximately half a mile into the river on a gradual curve starting near the eastern shore at a point about half a mile north of Paulding Avenue, Tarrytown.

The contract entails construction of triangular ice breakers to protect the northern face of each pier. Each will consist of 18 timber piles reinforced by oak sheath and faced with steel railing.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"Now that the Convocation has been convoked," began the Professor," and most of us were convoking for eleven days and eleven nights, I doubt that anyone recalls that last August we left three young hussies closing their daisy chain around Art and Ben with mischief in their eyes."

"Cal and I do," answered Joe Kerr. "There was a lull in the Convocation on Sunday night, so we dug up the data and worked it out. The chain was a triangle with the gals at the vertices and the gents at centers of inscribed and circumscribed circles. You gave us the radii $r = 16.8$ and $R = 53.3$ of the two circles and the altitude $h = 40$ of the triangle and asked for its base. We worked it out without much trouble, didn't we, Cal?"

"You mean *I* worked it out and *you* didn't have much trouble," sneered Cal Klater. "I'll bet you can't even remember *our* initial equations."

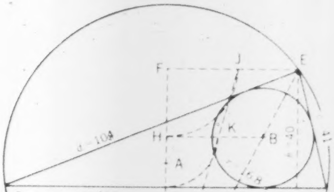


FIG. 1. Euclid puts the boys (A, B) and girls (C, D, E) in their places.

"Well, I wrote them down like this:

$$\frac{1}{2}eh = \frac{1}{2}r(c+d+e) = \frac{1}{4}cde/R = \frac{1}{4}\sqrt{[(c+d)^2-e^2][e^2-(c-d)^2]} \qquad (1, 2, 3)$$

Each was a formula for the area of the triangle, but with h, r and R known, we had three equations relating the unknown sides c, d and e opposite Cora, Dora and Elnora."

"All right, I take it back. First I used (1) to find $(c+d)$, and you said 'check.' Next I used (2) to find cd, and you said 'check.' Then I found $(c-d)^2$ from $(c+d)^2 - 4cd$, and you said 'check.' Finally I substituted these in (3) to find

$$e = \frac{2r}{h-2r}\sqrt{2hR - 4rR - r^2} = 105 \qquad (4)$$

and you said 'That's right!' That's how *we* did it!"

"Nicely done and nicely checked," smiled the Professor. "It's so nice that you agree on the answer. Incidentally, if we recognize the modulus $m = \sqrt{2hR - 4rR - r^2}/(h-2r)$, then we have: $e = 2mr$; $c + d + e = 2mh$; $c + d = 2m(h-r)$; $cd = 2hR$; area $= mhr$. From this, $c = 41$, $d = 104$ and area $= 2{,}100$.

"The figure shows how Euclid would have done it. On a line lay off FG = h and GH = r and draw circular quadrants GK and HJ. Draw line JK and extend to intersect FG at L. Lay off LA = R. Then with A as a center and R as a radius, draw the circumscribing circle, intersecting perpendiculars thru G and F at the vertices C, D and E. Also intersect EL and HK at B, the inscript center. It is interesting that GL $[= r^2/(h-2r)]$ and FL $[= (h-r)^2/(h-2r)]$ are invariants independent of R.

"Harmony-minded Toonerville has made railroad history with its pathetic complaint over the regular full-speed simultaneous passage of the Tweeter Limited and the Woofer Express, each blowing its whistle from yard limit to yard limit. It irked the sensitive ears of Toonerfolk to hear the shrieking discord of the approach followed by the wailing dissonance of the retreat. A slight change in train speeds made everybody happy, because approaching whistles sound a perfect fifth and retreating whistles a perfect fourth, separated by either a major third or a minor sixth if a train is a bit late. If that's modern railroad engineering, how fast is the Tweeter?"

[*Cal Klaters were: Joseph M. Brandstetter (who had suggested the pattern of the problem and the graphical solution), A. Nuther Nutt (as anonymous as ever), John L. (Stoop) Nagle, William C. Hunter, Lee Wellen (F. T. Llewellyn), Richard Jenney, S. K. Rueball (Keith Jones), Rudolph W. Meyer, Marvin (Sauer Doe) Larson, and Julian Hinds.*]

DECEASED

Frank Rea Allen (A.M. '17) consulting engineer and principal in the firm of Buxton & Allen of Little Rock, Ark., died in that city on May 29. He was 65 years old. Colonel Allen, who served in both World Wars, was the first military governor of Tunisia, commanding officer of the Civil Affairs Training School and professor of military science at Stanford University. Earlier he was employed for 17 years as assistant city engineer and city engineer for Pine Bluffs, Ark. Upon his retirement in 1947, Colonel Allen engaged in private practice. He was an alumnus of Ohio Northern University.

Donald Cochrane Andrews (M. '51) vice-president and director of the Turner Construction Co., of New York City, died in Eastchester, N.Y., on July 13, at the age of 50. Except for a brief period with O'Driscoll & Grove, Inc., of New York City, Mr. Andrews had been associated with the Turner Company continuously since 1925, advancing from rodman to the vice-presidency. Prior to 1925 he was employed for a year by the Fraser Brace Engineering Co., in Montreal, Canada. Mr. Andrews was a graduate of McGill University.

Blair Boyle (M. '27) civil engineer for the Kansas State Highway Department at Topeka, Kans., died on July 18, at the age of 71. A graduate of Purdue University, Mr. Boyle was surveyor for the Mississippi River Commission, city engineer at Altus, Okla., and resident engineer with the Little River Drainage District of Cape Girardeau, Mo. Beginning in 1918, Mr. Boyle served as county engineer of Geary County, then of Bourbon County, and in 1926 of Cowley County, Kans. From 1933 to 1939 he acted as regional director in the Public Works Administration, and he was associated with Fraser Brace at Hamden, Ark., for a period before joining the Kansas Highway Department.

Orris Bonney (M. '30) chief of the Columbus, Ohio, Division of Sewers, Drainage and Sewage Treatment, died at his home in that city, on July 9, at the age of 57. A graduate of the University of Michigan in 1918, Mr. Bonney served in the Sanitary Corps of the U. S. Army, and in 1919 became a draftsman in the city engineer's office in Detroit, Mich. He had been in the division of engineering and construction for the City of Columbus since 1923, advancing from engineer in charge of sewers to the position he held at the time of his death. In 1935, Mr. Bonney was the winner of the Rudolph Hering Medal for a paper in TRANSACTIONS.

Thomas Stephen Burns (M. '36) chief design engineer for Knappen-Tippetts-Abbett-McCarthy, consulting engineers of New York City, died on July 7, in Athens, Greece, where he was engaged in a study of flood control, irrigation and electric power production the company is making for the government of Greece. He was 62 years old. After serving in World War I as a lieutenant in the Corps of Engineers, Mr. Burns was with the Power Corporation of New York and the Northern Utilities, Inc., as a hydroelectric engineer. In 1930, he entered the U.S. Engineer Department and was chief of the Engineering Division in the Huntington, Zanesville, Eastport, Denison, Providence, Syracuse and Chicago Engineer Districts. Since 1948 he had acted as technical consultant on projects in New England, Argentina, and Colombia. Mr. Burns was an alumnus of the University of Wisconsin.

Hazleton Mirkil Chadwick (A.M. '18) irrigation engineer for Armco Drainage & Metal Products, Inc., Berkeley, Calif., died in December 1951, according to information recently received. He was 63. After studying at the University of Chicago, Mr. Chadwick was successively, hydrographer and assistant chief engineer for the Valier-Montana Land and Water Co.; chief engineer of the Rogue River Valley Canal Co., at Medford, Oreg.; assistant state engineer and secretary of the Desert Land Board of Oregon; and chief engineer of the Beall Pipe and Tank Corp., Portland, Oreg. For almost 15 years he served as engineer and district sales manager for the California Corrugated Culvert Co., at Berkeley, Calif., before joining the Armco company.

Percival Mitchell Churchill (M. '20) inspector for the Massachusetts Commission of Public Safety, Boston, Mass., died on February 13, 1952, at the age of 79. From 1921 until he joined the Commission in 1943, Mr. Churchill was in private practice as a consulting engineer in Boston and Elmwood, Mass. Earlier in his private career, he was connected with the U.S. War Department for six years and served the U.S. Reclamation Service for four years as assistant hydrographer and engineer. A veteran of World War I and a colonel in the Reserves, Mr. Churchill was educated at the Massachusetts Institute of Technology.

Charles Russell Ewing (A.M. '45) hydraulic engineer, Baltimore District, Corps of Engineers, died suddenly on July 13 while vacationing in his native village of Randolph, N.Y. He was 42. Except for a brief period of employment by the State of New York, Mr. Ewing had spent most of his professional career as a civilian employee of the Army Corps of Engineers. Beginning in 1937 as an inspector on construction, he advanced to chief of the planning and reports branch of the Baltimore District. He was an alumnus of Ohio Northern University.

Clement John Howard (M. '20) associate engineer for Robert J. Cummins, consulting engineer of Houston, Tex., died in that city on July 11. He was 70. After receiving a degree in civil engineering from the University of Texas in 1903, Mr. Howard worked for several railroad companies, the Texas Company, and served as assistant city engineer and city engineer for Corpus Christi, Tex. He had been associated with the firm of Robert J. Cummins for more than 20 years.

Charles Burridge Hawley (M. '18) president of the Charles B. Hawley Engineering Corp., Washington, D.C., died on July 26, at the age of 66. After graduating from the Case School of Applied Science, Mr. Hawley worked for the Cleveland Cliffs Iron Co., Ishpeming, Mich.; the Fargo Engineering Co., Jackson, Mich.; and the Aluminum Company of America at Pittsburgh, Pa. In 1920, he entered private practice in Washington, D.C., later becoming president of the Charles B. Hawley Engineering Corp., which specializes in hydroelectric developments. Mr. Hawley had been connected with such projects as the Kaneiri River Dam, New Zealand; the Botocan development, Philippine Islands; and the Piney development near Clarion, Pa.

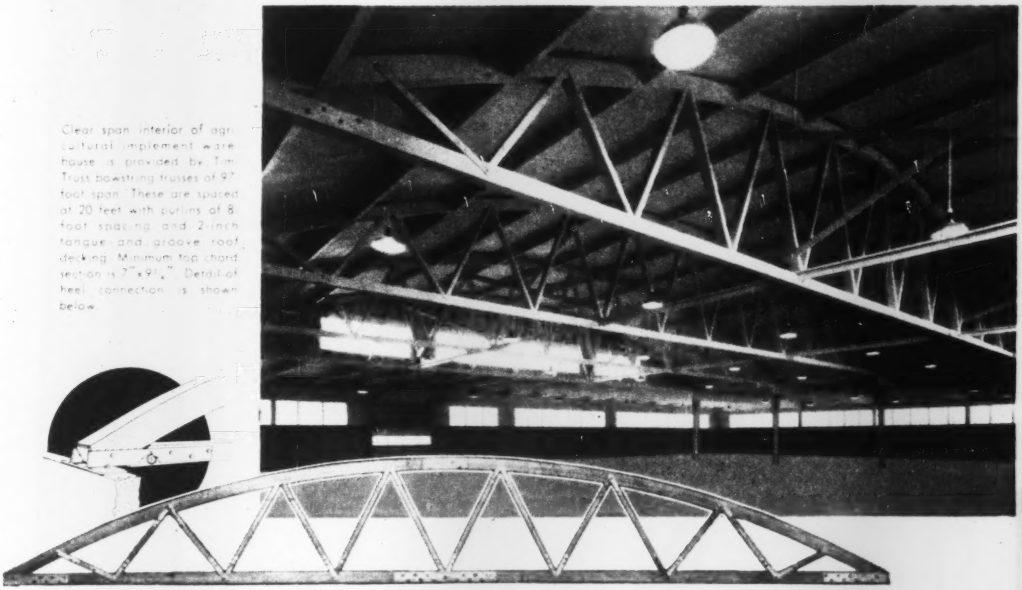
George William Howson (M. '45) senior engineer, U.S. Bureau of Reclamation, at Sacramento, died in Oakland, Calif., on August 7, at the age of 69. After graduating from the University of California, Mr. Howson worked for the Sierra and San Francisco Power Co., for ten years. Before joining the Bureau of Reclamation in 1941, he was connected with Ford Bacon & Davis of New York City, the Kentucky Utilities Co., the Lexington Utilities Co., and the Public Works Administration. He had been engaged on such projects as the Dix River development in Kentucky, Strawberry Dam in California, and the Stanislaus River development.

Richard Edwin Graves, Jr. (J.M. '50) sales engineer for Euclid Road Machinery of Butler, Tenn., died in Memphis, on July 26, at the age of 28. A Marine veteran of two years' service in the Pacific area during World War II, Mr. Graves had attended Memphis State and received a civil engineering degree from the University of Tennessee in 1950. He had been associated with Euclid Road Machinery since his graduation.

Edward Cecil Gwillim (A.M. '25) consulting engineer of Sheridan, Wyo., died on December 31, 1951, at the age of 64. After serving as city engineer of Sheridan from 1919 until 1934, Mr. Gwillim entered the U.S. Department of Agriculture as chief engineer and manager of the Wyoming Rural Rehabilitation Corp., at Cheyenne, Wyo. Later he advanced to senior water planning analyst. Since 1944, Mr. Gwillim had been engaged in private practice in Corvallis, Oreg., and Sheridan. He attended the Colorado State College and the Colorado School of Mines.

Theodore Lovel Donner Hadwen (M. '16) retired railway engineer of Chicago, Ill., died in that city on June 5. He was 80. Associated with the Chicago, Milwaukee, St. Paul and Pacific Railway during his entire career, Mr. Hadwen's work included the positions of assistant engineer, engineer on masonry construction, and office engineer in charge of the district office. He retired in 1937. A native of England, he was a graduate of St. Paul's, and the City and Guilds of London Institute, both in London.

(*Continued on page 90*)



Clear span interior of agricultural implement warehouse is provided by Tim-Truss bowstring trusses of 97-foot span. These are spaced at 20 feet with purlins of 8-foot spacing and 2-inch tongue-and-groove roof decking. Minimum top chord section is 7"×9½". Detail of heel connection is shown below.

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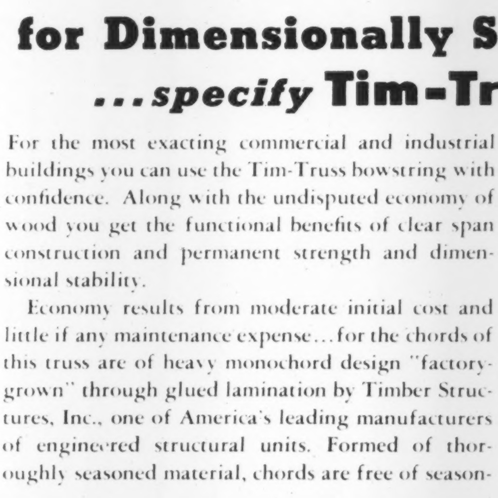
...*specify* Tim-Truss Bowstring

For the most exacting commercial and industrial buildings you can use the Tim-Truss bowstring with confidence. Along with the undisputed economy of wood you get the functional benefits of clear span construction and permanent strength and dimensional stability.

Economy results from moderate initial cost and little if any maintenance expense...for the chords of this truss are of heavy monochord design "factory-grown" through glued lamination by Timber Structures, Inc., one of America's leading manufacturers of engineered structural units. Formed of thoroughly seasoned material, chords are free of seasoning action. When used with heavy roof decking and concrete or masonry walls they qualify as heavy timber construction, with resulting favorable insurance rates.

Available in spans up to 150 feet or more, the Tim-Truss is adaptable for single or multiple spans in a variety of roof contours.

For full information about timber trusses, let us send you a copy of the data-packed booklet, "Engineered Timber Construction". Just fill in and mail the coupon.



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(Continued from page [illegible])

William Bower Clemmer (Aff. '30) superintendent of construction for the James Baird Co., of Washington, D.C., died at his home at Wildercroft, Md., on July 4. He was 73. Mr. Clemmer had been with the James Baird Co., continuously since 1926. Earlier (1908–1926) he was employed as superintendent of construction for the George A. Fuller Co. Mr. Clemmer supervised construction of major building projects in the Washington, D.C., area, including the Folger Shakespeare Library, the Munsey building, and the White House swimming pool.

Claude Leon McKesson (M. '28) vice-president and director of engineering and research for American Bitumuls Co., of San Francisco, Calif., died on July 21, at Altadena, Calif. He was 71. In the early part of his career, Mr. McKesson was connected with the Bureau of Public Roads in Oregon, Washington, Utah and Montana, as senior highway engineer. Following that he was associated with William Mulholland, the City of Los Angeles, and the California State Highway Department. Mr. McKesson joined the American Bitumuls Co., in 1928 and had been serving as a consultant to the firm since his retirement in 1946 from active participation in the company.

Willis Taylor Knowlton (M. '21) consulting sanitary engineer of Los Angeles, Calif., died on June 17 at the age of 81. He had been concerned with the sewage and sanitary problems of the City of Los Angeles for many years, acting as general supervisor of sewers and sewage disposal, engineer of sewers, and as sanitary engineer in the Bureau of Engineering from 1923 to 1941. Since 1941 Mr. Knowlton had been engaged in private practice as a consultant. He was an alumnus of the Massachusetts Institute of Technology.

Ernest Warren Seemann (M. '38) structural engineer with Merritt Chapman and Scott in New York, N.Y., died there on June 10, at the age of 57. A graduate of the University of Minnesota, Mr. Seemann was connected with the Elgin, Joliet & Eastern Railway, Cowin & Co. and the Truscon Steel Co., of Minneapolis, Minn., the Steel Service Co., of San Francisco, Whitney Bros. Co., of Duluth, and the Portland Cement Association. He joined the firm of Merritt Chapman & Whitney in 1931 and had been with its successor firm, Merritt Chapman and Scott since 1936.

Franklin Peter Ulrich (M. '38) chief of the Seismological Field Survey, United States Coast & Geodetic Survey, died in San Francisco on July 3. He was 61 years of age. A graduate of Union College, Mr. Ulrich had been with the Survey since 1914. Until 1928 he served as a magnetic observer in charge at Tucson, Sitka and Washington, and he had been chief of party for the Magnetic Survey of the United States and Alaska. Since 1936, Mr. Ulrich had been in charge of the California Seismological Field Survey.

Lewis Abner Howland (M. '13) retired engineer of Far Rockaway, N.Y., died on June 12, at the age of 78. After graduating from Worcester Polytechnic Institute, Mr. Howland worked for the E. G. Bernard Co., at Troy, N.Y., and the Stanley Electric & Manufacturing Co., at Pittsfield, Mass., and Montreal, Canada. Following that he served as manager for the Newfoundland Light & Power Company at St. John's, J.G. White & Co., and the Nassau (Long Island) Light & Power Co. He then began a long career with the Queens Borough Gas & Electric Co., of Far Rockaway, as general superintendent and chief engineer, acting as general manager of the organization from 1927 until his retirement in 1944.

Francis Patrick Walters (A.M. '41) engineer associated with William Casey & Sons, Inc., engineers and contractors of New York, N.Y., died on July 5, at the age of 48. Mr. Walters was with the Baltimore & Ohio Railroad Co., for much of the period from 1929 to 1936, advancing from rodman to construction engineer and designer. He was then connected with the Bates & Rogers Construction Co., in charge of field engineering, the Jersey Central Railroad Co., as supervising engineer, E. W. Foley, Inc., as office engineer and designer, George F. Collins Co., as superintendent, and Frederic R. Harris, Inc. Mr. Walters was a graduate of the University of Maryland.

James Benjamin Ward (A.M. '50) geologist, and a member of the staff of Knappen-Tippetts-Abbett-McCarthy, died on July 9, in Port-au-Prince, Haiti, where he was working on the Artibonite River development project. He was 37. Beginning in 1933, Mr. Ward was connected with the Tennessee Valley Authority in several capacities, including resident engineering geologist in connection with construction of Hiwassee Dam, Fort Loudoun Dam and several others. Mr. Ward also served as district geologist for the Testing and Geology Section of the U.S. Engineer Office at Mobile, Ala. He was an alumnus of the University of North Carolina.

Edward Franklin Wilsey (A.M. '38) professor of civil engineering at Ohio University, died at his home in Athens, Ohio, on June 30. He was 51 years of age. After graduating from the University of Iowa, Dr. Wilsey taught theoretical and applied mechanics at the University of Illinois for four years, and was associate professor and then head of the department of physics at Robert College, Istanbul, Turkey. For two years, he was associated with the U.S. Bureau of Reclamation at Denver, Colo. Dr. Wilsey joined the faculty of Ohio University in 1938 and was in charge of the development of a new hydraulics laboratory.

William Clayton Witt, Jr. (J.M. '49) of Dallas, Tex., was killed in an automobile accident on August 24. He was 25 years of age. Since his graduation from Southern Methodist University, in 1949, with the civil engineering degree, Mr. Witt had been engaged by the Trinity Company of Dallas, as a foreman.

NEWS OF ENGINEERS

Francis V. Bulfinch announces a change in the name of his engineering firm from Coolidge Shepley Bulfinch & Abbott to Shepley Bulfinch Richardson & Abbott. Other members of the firm, which has its headquarters in the Ames Building, Boston, Mass., are **Henry R. Shepley, Joseph P. Richardson** and **Lewis B. Abbott.**

Jonathan Jones

Jonathan Jones, Honorary Member of ASCE and chief engineer of fabricated steel construction for the Bethlehem Steel Company, Bethlehem, Pa., is retiring after serving the organization for 21 years. For 11 years he was associated with the McClintic-Marshall Company, which Bethlehem acquired in 1931. During a career covering nearly half a century, Mr. Jones has gained wide recognition as one of the foremost structural engineers. He will be succeeded by **Ethan F. Ball,** now assistant chief engineer of bridges and buildings.

Ralph R. Tinkham, retired captain, U.S. Coast Guard, was recently appointed city building inspector for Santa Rosa, Calif.

Donald W. Van Tuyl, hydraulic engineer with the U.S. Geological Survey, in Philadelphia, Pa., has accepted a position as water resources assistant in the Natural Resources Division of the U.S. Chamber of Commerce, in Washington, D.C.

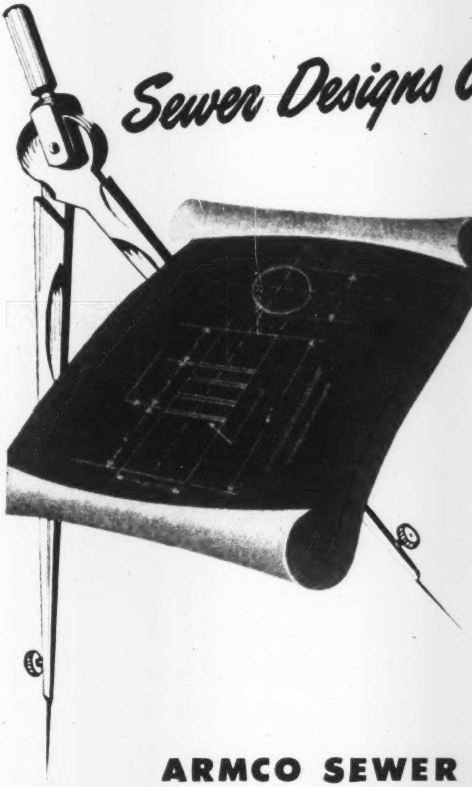
John D. Slye, district engineer for the Wyoming District of the U.S. Bureau of Public Roads, recently retired after serving with the Bureau since 1919. Mr. Slye has had assignments throughout Wyoming, New Mexico and Colorado.

Alfred Crew has opened an engineering office in Ridgewood, N.J., specializing in the field of sanitary engineering. Until recently engaged as a civil engineer by the New York firm of Havens & Emerson, Mr. Crew has had wide experience on municipal and other projects.

John G. Duba, instructor of civil engineering at the Illinois Institute of Technology, has been promoted to the rank of assistant professor.

(Continued on page 92)

Sewer Designs Are No Good... on paper!



The best of sewer designs are of little value until they are incorporated into a functioning conduit. Even then the conduit must have adequate strength and material durability to maintain your specifications throughout its normal life. This is why many experienced engineers are specifying Armco Corrugated Metal Sewers.

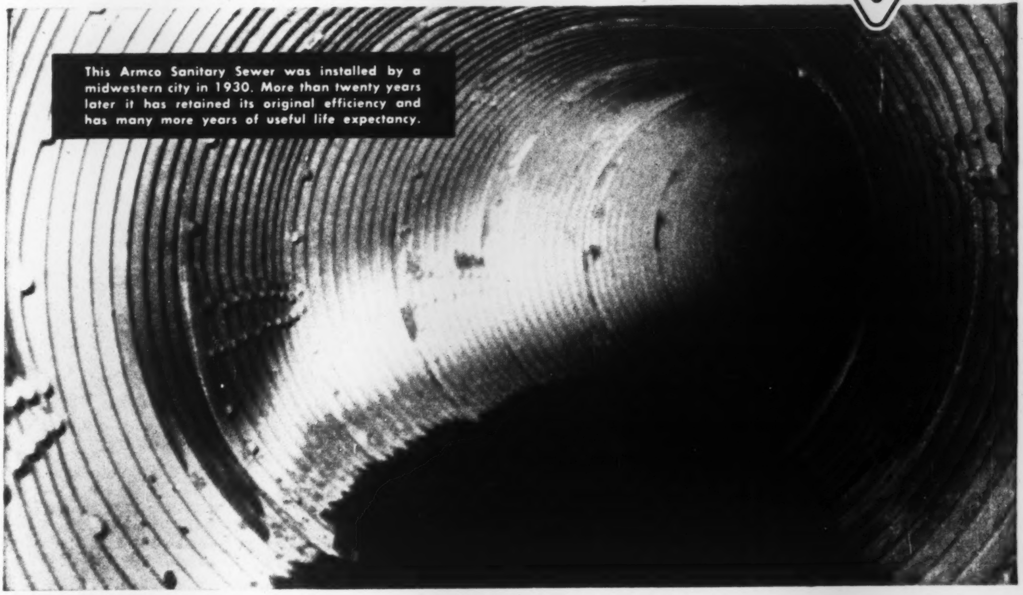
Consider the importance of structural strength. The designed value of any sewer will change unless it retains grade and alignment, has tight joints to prevent infiltration of ground water and solids, as well as material strength to withstand the impact and vibration of heavy traffic.

Armco Sewers meet these requirements. Long lengths help bridge soft spots in the foundation. Sturdy coupling bands assure tight joints and a continuous conduit of uniform strength that will not open up or pull apart. The proved strength of flexible corrugated metal design is assurance against crushing or cracking.

And no matter what service conditions are encountered there is a type of Armco structure to meet the exact requirements. Erosion is handled by Armco PAVED-INVERT Pipe. For severe corrosive conditions there is durable ASBESTOS-BONDED. Easily erected MULTI-PLATE is ideal for large structures and either Standard Corrugated or MULTI-PLATE PIPE-ARCH will save time and money when headroom is limited.

Write for complete information regarding your specific needs. Armco Drainage & Metal Products, Inc., 1172 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

ARMCO SEWER STRUCTURES



This Armco Sanitary Sewer was installed by a midwestern city in 1930. More than twenty years later it has retained its original efficiency and has many more years of useful life expectancy.

News of Engineers

(Continued from page [illegible])

George E. Arnold, formerly director of the water resources division of the National Production Authority in Washington, D.C., was recently named deputy commissioner of the water operations bureau of the Philadelphia Water Department. **Max Barofsky,** principal assistant engineer and member of the Department of Public Works since 1921, was appointed deputy commissioner of the sewer operations bureau.

Robert W. Briggs, consulting engineer of New Rochelle, N.Y., has been appointed consultant for New York and Connecticut on construction of a $1,000,000 interstate bridge across the Byram River. The span will connect the New York Thruway and a new Connecticut highway near Port Chester, N.Y. At present Mr. Briggs is designing the New England section of the Thruway from New York City to the Connecticut line.

William G. Buecheler, architect and engineering consultant of Jacksonville, Fla., and colonel in the United States Army Reserve, is on a tour of active duty at Fort McPherson, Ga. Colonel Buecheler is serving as deputy engineer in the engineering section of Third Army Headquarters.

A. Brinton Carson, contract consultant of Havertown, Pa., announces the opening of an office in the Colonial Building, Wayne, Pa., where he will continue to provide a comprehensive service for contractors and engineers.

Maurice H. Ellis, until recently engineering salesman with the Southwestern Insulation & Materials Co., at Springfield, Mo., is now associated with the Portland Cement Association in Kansas City, Mo.

Ernest L. Eustis, Jr., commander, CEC, USNR, has been appointed officer in charge of the Navy Civil Engineer Corps Officers School, at Port Hueneme, Calif. Previously, Commander Eustis was deputy coordinator of overseas construction, Navy Bureau of Yards and Docks.

Lewis H. Kessler, since 1946 professor of sanitary engineering at the Technological Institute of Northwestern University, has been named chief hydraulic engineer for the Beloit, Wis., works of Fairbanks, Morse & Co., Chicago.

Neal Dow McDowell, highway engineer for the U.S. Bureau of Public Roads, has been promoted to the position of district engineer for Maine, to fill the position left vacant by the death of **Henry Fallon.** A member of the Bureau for 24 years, Mr. McDowell has been serving in Maine since 1945. He is currently serving as president of the Maine Section of ASCE.

Frank Maguire, until recently on active military service with the Corps of Engineers in the Japan Logistical Command, has entered the employ of Whitman, Requardt and Associates of Baltimore, Md.

L. A. Elsener

L. A. Elsener, manager of the Chicago Bridge & Iron Company's San Francisco office, was elected a vice-president of the company on September 3. Associated with the organization since his graduation from college in June 1922, Mr. Elsener was a contracting engineer in the company's San Francisco office from September 1923 to July 1928 and has been manager of the office since then. He is serving as chairman of the San Francisco Convention of ASCE to be held March 2-7.

Wade Ellis Peebles, who has been with the California State Division of Highways since 1941, was recently appointed chief deputy city engineer for Inglewood, Calif. He was previously engineer for the Division's Los Angeles office.

Clyde B. Pyle, contract officer for the U.S. Veterans Administration in Philadelphia, Pa., has retired after 25 years of engineering work in structural design and construction.

Donald B. Hope, assistant resident engineer with the Virginia Department of Highways at Wise, Va., has been promoted to resident engineer for Giles, Montgomery and Pulaski counties. A graduate of Purdue University, Mr. Hope joined the Department of Highways in 1947.

F. A. Wallace, who recently received a doctorate in civil engineering from the Carnegie Institute of Technology, has returned to his position as professor and head of the department of civil engineering at the College of the Pacific, Stockton, Calif.

Marvin J. Webster, head of the Bonneville Hydraulic Laboratory, Bonneville, Oreg., has been awarded a certificate for meritorious performance of duty in connection with hydraulic model studies of the Dalles Dam on the Columbia River.

T. T. Wiley, acting traffic commissioner for New York City, has become commissioner in charge of the department. Before coming to New York as a traffic expert, he was deputy city traffic engineer in Detroit for several years.

Lowell W. Markert, for the past two and a half years civil engineer with the Bureau of Research and Planning, Illinois State Division of Highways, at Springfield, Ill., has been awarded a fellowship of the Automotive Safety Foundation, and will study at the Bureau of Highway Traffic at Yale University this fall.

T. Felix Hickerson has retired as professor of engineering and mathematics at the University of North Carolina—a position he has held since 1905.

Roy W. Douthitt, lieutenant, CEC, USN, has assumed the duties of resident officer in charge of construction of a plant being built by Bendix Aviation Corp., for the Navy. Since his recall to active duty in November 1951, Mr. Douthitt has been serving as assistant resident officer in charge of construction of a jet engine plant being built by the Chrysler Corp. for the Navy's Bureau of Aeronautics.

John M. Counts, former project manager of the Wilson Projects Branch of the Tennessee Valley Authority at Johnsonville, Tenn., has accepted a position as project manager with Ebasco Services, Inc., of New York. Mr. Counts will be engaged by the Cia Auxiliar de Empresas Electricas Brasileiras on a hydroelectric development at Franca, Brazil.

Edward J. Baldinger, assistant professor of civil engineering at the University of Dayton, Dayton, Ohio, has been named head of the department of civil engineering.

Nicholas A. Rose, consulting groundwater geologist, announces the removal of his office to 1010 Dennis Avenue, Houston, Tex.

H. Birchard Taylor, Philadelphia engineer, industrialist and author, will be awarded an Elliott Cresson Medal by the Franklin Institute. Formal presentation of the medal will take place at the Institute's annual Medal Day ceremonies in Franklin Hall, October 15.

D. B. Steinman, consulting engineer of New York, has been awarded the Cross of Commander of the Grand Prix Humanitaire de Belgique, and the award of the Cross of Commander of the Order of Cyprus and Jerusalem.

Paul A. Kelly, who terminated his partnership in the firm of Kelly & Gruzen, architect engineers of New York, N.Y., on June 30, is now associated with York and Sawyer, in their New York office.

Raymond J. Rosenberger, specifications engineer for the J. E. Greiner Company, of Baltimore, Md., has been assigned by the firm to the Ohio Turnpike project as engineer of contracts and specifications. His headquarters will be 2012 West 25th Street, Cleveland 13, Ohio.

John S. McNown, associate director in charge of the Iowa Institute of Hydraulic Research and **A. L. Alin,** professor of hydraulic engineering at the State University of Iowa and a consulting engineer in Omaha, Nebr., presented a series of lectures during the summer, at the National University at Bogota, Colombia.

(Continued on page 94)

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

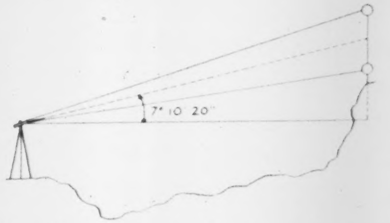
Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Do you use the gradienter?

"Very few field men realize the value of the gradienter," says Henry M. Stanley, Construction Engineer for The Virginian Railway Company. "But, in rough terrain, the addition of a gradienter screw to a transit can save many a headache.

"When neither tape nor ordinary stadia can do the job, the gradienter will give you a reading in a few minutes. This method was a real life saver for me when I was with the Forestry Service out through North Carolina, western Virginia, and eastern Tennessee.

"**Here is how it worked** near Roan Mountain, Tennessee. I placed plywood targets, 12 inches in diameter, at the 1-foot and 25-foot marks of the stadia rod on the other side of a ravine. Setting the middle crosshair on the bottom target, I found the gradienter was at 18. I then brought the middle wire to the top target, using the gradienter screw, and read 50.5 on the gradienter. The difference in reading was 82.5 units.



Using the gradienter, H. M. Stanley quickly found horizontal distance across a Tennessee ravine.

"The angle representing 1 to 100 equals 0° 34′ 22.5793″ or 2062.5793″. A unit on the gradienter is 1/100 of this, or 20.625793″.

"**Using logarithms,** I made the following calculations: 20.625793″ times 32.5 units equals 670.338″. The subtended interval on the rod was 24′. Therefore, 24 divided by tangent 670.338″ equals the distance to the rod, 7384.8′. The vertical angle was 7° 10′ 20″. Distance to the rod times cosine 7° 10′ 20″ equals 7327.0′—the horizontal distance.

"I have done many types of surveying in my day. Each kind requires a good instrument. On my present railroad job, my chief has just turned a new Gurley over to me. I don't believe I've ever had anything better to use."

H. M. Stanley, Construction Engineer, Virginian Railway Company, sights with his Gurley Transit.

Have you received your copy of "*The Surveyor's Notebook*" collection? It contains all the stories from the first year's series. Thousands of surveyors are finding it helpful. You will, too, for it includes many valuable tips for using your surveying instruments with greater success and pleasure. Write today for a free copy.

The Surveyor's Notebook

The gradienter screw (or Stebbinger drum) is standard with Gurley alidades. It can also be added to your present Gurley transit. Write for details.

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GURLEY

Surveying and Scientific Instrument Makers

Since 1845

News of Engineers

(Continued from page 92)

John M. Henderson, until recently professor of sanitary science in the Columbia University School of Public Health, has been appointed a consultant to Vector Control and Investigations Branch of the Communicable Disease Center, Public Health Service, Federal Security Agency. His headquarters will be in Atlanta, Ga.

Elliott E. Brainard, who recently joined the American Pipe and Construction Co., in Los Angeles after a number of years as an executive of Lock Joint Pipe Company, has become sales vice president. The company's chief engineer, **H. L. White,** becomes vice president in charge of the San Francisco area.

Stanley J. Lewis of Houston, Tex., has been transferred from the East Texas division office of Humble Oil & Refining Co., at Tyler, to their Louisiana division office in New Orleans, as assistant division civil engineer.

A. J. Gates, formerly chief sales engineer for Norcam Co., Dallas, Tex., has accepted appointment as southwestern representative of Pipe Linings, Inc., of Los Angeles, Calif. Mr. Gates' experience includes engagements as superintendent and engineer for the Wichita Falls, Tex., Water Department, and business manager for Midland, Tex.

Robert G. Scott, for 16 years chief engineer of the Clay Products Association, has been appointed vice president and general manager.

Thomas M. Lowe, Jr., has been named project engineer in the photogrammetric mapping department of Michael Baker, Jr., Inc. Since his graduation from Alabama Polytechnic Institute in 1949, Mr. Lowe has been in the Jackson, Miss., office of Michael Baker, Jr., Inc.

Carl W. Schoene, engineer of the Columbus, Ohio, Division of Sewers and Drains, has been designated chief of the division.

George N. Schoonmaker has retired from the firm of Jones, Henry & Schoonmaker, engineering organization of Toledo, Ohio. The remaining partners will continue the practice under the name of Jones, Henry & Williams.

Albert T. Simpson, structural designer for Hall & Pregnoff of San Francisco, Calif., and **James L. Stratta,** civil engineer for the same company, have opened consulting engineering offices in San Francisco.

Howard I. Stites, former city manager of Burbank, Calif., was recently appointed inspector of Public Works and special assistant to the Board of Public Works of the City of Los Angeles.

Roscoe H. Suttie, professor of civil engineering at Yale University, has retired after serving on the faculty for almost 40 years. He joined the staff in 1913 as an instructor and, except for one year with the U.S. Geological Survey, has served the university without interruption since.

Charles W. Lovell, field engineer for the Portland Cement Association, at Louisville, Ky., for the past 18 years, has been named an engineer for the Ohio Turnpike and will be in charge of construction of a section between Cleveland and Toledo. He is president of the Kentucky Section of ASCE.

Wesley King, has resigned as civil engineer with the Tennessee Valley Authority at Knoxville, Tenn., to accept a position with E. I. Du Pont in Chattanooga.

William H. Quirk has been promoted from Eastern editor to editor of *Contractors and Engineers Monthly,* whose offices are located in New York City.

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Nov. 12-16, 1952

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Non-ASCE Meetings

American Public Health Association. Headquarters for the 80th annual meeting of the American Public Health Association, which will be held in Cleveland, Ohio, from October 20 to 24, will be the Cleveland Public Auditorium.

American Institute of Electrical Engineers. The fall general meeting of the American Institute of Electrical Engineers will be held at the Jung Hotel, New Orleans, La., October 19-23.

American Society of Safety Engineers. A construction symposium, presenting talks by representatives of the Army Corps of Engineers, and the contracting and insurance industries, will be featured during the 40th National Safety Congress and Exposition, to be conducted by the American Society of Safety Engineers in Chicago, Ill., October 20-24.

American Welding Society. The 33rd national fall meeting of the American Welding Society will be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., during the week of October 19. The society will also participate as one of the sponsoring organizations in the National Metal Exposition.

National Metal Exposition and Congress. The 34th National Metal Exposition and Congress will be held in Philadelphia from October 18 to October 24. Technical sessions of the sponsoring societies will be held at several Philadelphia hotels, and the Exposition in the Philadelphia Convention Hall. Room reservations may be made through George Sikorski, Philadelphia Convention Visitors Bureau, 17th and Sansom Streets, Philadelphia 3, Pa.

Conference on Coastal Engineering. The third conference on coastal engineering, a joint effort of the Council on Wave Research of the Engineering Foundation and the Massachusetts Institute of Technology, will be held on the campus of MIT, Cambridge, Mass., from October 22 to 24.

Industrial Management Society. "Broadening the Field of Industrial Engineering" is the theme of the 16th annual time and motion study and management clinic, sponsored by the Industrial Management Society, which will be held November 5-7, at the Sheraton Hotel, Chicago, Ill.

Society of Automotive Engineers. The national transportation meeting of the Society of Automotive Engineers, will take place at the Hotel William Penn, Pittsburgh, Pa., from October 22 to 24.

Highway and Surveying Conference. Under the sponsorship of the civil engineering department of the University of Florida, and as a function of the Engineering and Industrial Experiment Station, a highway and surveying conference will be held on the university campus at Gainesville, Fla., on October 23 and 24.

SPEEDCRANE

Denver builds gigantic storm sewer with 9 miles of *CONCRETE PIPE*

To encourage orderly growth Denver is developing a new addition of 1700 acres—70 per cent for residential and 30 per cent for industrial expansion. To serve this area the city installed the new Northeast storm sewer—using over nine miles of concrete pipe.

The photo above shows a trench being dug 20 ft. deep for 72-in. pipe. All the pipe was placed in open trenches. The sizes and quantities of concrete pipe used in the job are listed at right.

Hundreds of other cities from coast to coast have found that concrete pipe carries off large volumes of water efficiently. Concrete pipe has the strength to resist severe impact and sustain heavy overburdens. Its smooth interior resists abrasion and provides maximum hydraulic capacity. It is moderate in first cost and has the durability to render long years of service with little or no upkeep expense. The result is ***low-annual-cost*** sewer service.

Sizes and Quantities of Concrete Pipe in Northeast Storm Sewer

7,780 ft. of 72 in. dia.
315 ft. of 66 in. dia.
4,020 ft. of 60 in. dia.
5,565 ft. of 54 in. dia.
12,480 ft. of 48 in. dia.
6,060 ft. of 42 in. dia.
4,436 ft. of 36 in. dia.
912 ft. of 33 in. dia.
340 ft. of 27 in. dia.
672 ft. of 24 in. dia.
700 ft. of 21 in. dia.
5,552 ft. of 12 in. dia.

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Men Available

Civil Engineer, J. M. ASCE, graduate, 29, married, 3 years New York City contractor's experience, take off, pricing, field supervision, industrial and speculative building, heavy concrete experience. Desires relocation, Texas or Southwest. C-770.

Civil Engineer, J. M. ASCE, B.S., M.S. and degree of engineer in structures, age 29, 3 years foreign and domestic experience in general engineering, including design, scheduling, construction supervision, inspection, etc., of buildings and utilities. Desires position with structural engineer or engineering firm. Location preferred, California or foreign. C-771.

Civil and Sanitary Engineer, J. M. ASCE, 26, single, B.S. 1951, University of California, in civil and sanitary engineering, 1 year of experience in field work, drafting and simple design; field work consisted of preliminary surveys in building layout, pipe lines, roads and drainage structures. Design of small warehouses, culverts, retaining walls and roads. Location preferred, San Francisco, Calif. C-772-522-A-8-San Francisco.

Civil Engineer, J. M. ASCE, 26, married, B.S. in C.E. 1951, 1 year as materials and construction engineer in concrete construction. Registered engineer in training, Colorado. Desires position with a future in municipal engineering or with consulting firm. Prefers combination field and office work. C-773-527-A-9-San Francisco.

Structural Engineer, A. M. ASCE, 39, married, registered professional engineer (Michigan). Broad and diversified design experience including warehouses, hospitals, docks, highway bridges, industrial buildings, residences, etc. Just completing active duty with Naval Reserve. Desires design or administrative position with engineering or industrial organization. East coast location preferred. C-774.

Sanitary and Civil Engineer, A. M. ASCE, 35, married, 12 years' experience in design, construction and operation of water and sewage systems and treatment plants, public health engineering, planning and layouts for municipalities and military bases, reinforced concrete design. Desires high degree of responsibility and an adequate salary. C-775-505-A-2-San Francisco.

Civil Engineer, M. ASCE, 30, married, M.S. in C.E., 8 years' experience design, layout, superintending large construction. Can design frame structures, concrete, steel. Available the 17th of September. Desires permanent position in design or construction. Speaks Spanish fluently. Prefers location South, West, and will consider work in Latin America. C-776.

Civil Engineer, J. M. ASCE, 33, married, 2 children, B.S. in C.E., 11 years on precision surveying and mapping with limited construction experience. Speaks Spanish. C-777.

Civil Engineer, J. M. ASCE, 30, married, B.S. in C.E., 2 years military engineering, summer jobs drafting and soils testing, laboratory instructor in hydraulics and materials testing during senior year, over 2½ years self-employed technical writer-editor. Desires position with firm engaged in civil engineering. United States or overseas. C-778.

Civil Engineer, M. ASCE, graduate, 40, married, California Registered Civil and Mechanical, experienced project planning and management, public and private works, civil, hydraulic and mechanical. Equally capable design, supervision, construction. Good personnel manager. Available for exceptional opportunity. Location preferred, western United States. C-779-525-A-6-San Francisco.

Civil Engineer, J. M. ASCE, 26, single, B.S. in C.E., June 1949, University of Wisconsin, 3 years' experience in photogrammetry and reclamation, including 9 months' construction on roadways and dams. Desires position in construction to eventually enter consulting field. C-780-528-A-5-San Francisco.

Construction Cost Analyst, A. M. ASCE, 43, married, 3 years' college, 16 years' engineering and construction experience includes 4 years' analysis of industrial construction unit cost, construction methods, materials, schedules, progress, labor and equipment utilization. Desires employment offering opportunity for advancement. C-781.

Civil Engineer, A. M. ASCE, 34, married, graduate, registered. Ten years' experience in airdrome construction, refinery piping and piping design, power plant construction, dock, marine and tankage construction; land surveyor in Texas only. Willing to move as required by job conditions. Desires domestic or foreign work, in any section of any country except extreme tropics. C-782.

Civil Engineer, J. M. ASCE, graduate, registered, 10 years' varied experience, field and office. Four years in Latin American countries as water works engineer. Two years' experience in design and construction of airfields. Desires permanent position. C-783.

Positions Available

Foundation Engineer with 10 years' experience designing heavy foundations and bridge piers. Advanced degree in structures desirable. Knowledge of soils mechanics essential. Capable departmental responsibilities in small organization. Location, East. Y-6776.

Civil Engineer, graduate, 26-30, for design and field work in municipal engineering. Salary, $3,600-$4,800 a year. Location, northern New Jersey. Y-6916.

Civil Engineer, 40-45, with 10-15 years' experience in structural design and office engineering experience—to prepare plans, specifications, etc., on oil field construction projects. Salary, $11,640 a year base pay plus $4,200 a year living allowance. Location, South America. Y-7112.

Chief Engineer, B.S. in civil, architectural or mechanical engineering with 8 to 12 years' engineering in industry; background in refrigeration equipment, food processing, hardware design or insulation helpful. Will be responsible for leadership in field of product development, proper application of product to meet customer's needs, adequate manufacturing instructions, supervision of drafting personnel. Company manufactures cold storage doors and employs about 200. Salary, about $8,000 a year. Location, mid-Atlantic States. Y-7178.

Teaching Personnel to teach or do lecturing in surveying, hydraulics, structural engineering, power, telecommunications, electrical engineering, mechanical, architectural, chemical, aeronautical engineering, physics, metallurgy. Salaries open. Location, Israel. Y-7209.

Resident Engineer, civil graduate, to take complete charge of the construction of a large paper mill in Georgia. Salary, open. Y-7262.

Engineers. (a) Construction superintendents. Three for overseas duty and one for domestic. Must have minimum of 8 to 10 years' experience

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in the construction of hydroelectric power stations. Salary, $15,000 a year plus 20% for overseas service. (b) Resident engineers for similar work as above. Salary, $9,000 a year. Headquarters, New York, N.Y. Y-7350.

Manager of Building Products Sales, 35-40, with sales background and engineering experience, for work involving the development of new building products. Must be able to handle normal sales management and advertising duties and have imagination and the ability to produce new products. Salary, $7,000 a year to start. Location, Ohio. Y-7453.

Assistant to the President, 35-40, with engineering degree desirable. Must have thorough training and experience in structural steel. Should possess an accounting familiarity, engineering competence and management experience or capabilities. Initial responsibility will involve the budget program and will then assume additional management responsibilities. Salary, $15,000 a year, dependent on background. Location, Midwest. Y-7472 R-6706.

Sanitary Engineer, civil graduate, with at least 5 years' experience in design and operation of sewage collection and disposal systems and a thorough knowledge of sanitary requirements for municipal operations. Salary open. Location, Pennsylvania. Y-7440.

Professor in civil engineering, 35-40, for the school year 1953-54, to act as department head. Should have engineering and teaching experience. Salary, $4,500-$5,000 for 9 months. Location, Pennsylvania. Y-7446.

Civil Engineers to do detailing and computing of reinforced concrete and steel structures on design of power houses and dams. Location, Quebec, Canada. Y-7448.

Engineers. (a) Resident engineer with at least 5 years' experience covering railroad or highway engineering, aerial survey, layout, curves, solar observations. Salary, $9,600 a year. (b) Instrument man with railroad or highway field experience, to run level and transit covering locations and construction. Salary, $7,200-$8,400 a year. (c) Office engineer with at least five years' railroad and highway experience including design and computation work. Salary, $10,000 a year. (d) Draftsman computer to compute field notes, lay out right of way, do topographical work, etc., on railroad project. Salary, $7,200 a year. Knowledge of Spanish and Portuguese desirable. Bonus of 15% on all jobs at completion of contract, two to three years' work. Location, Brazil, South America. Y-7452.

Civil Engineer, graduate, with at least 3 years' design, layout, specification and field engineering, to do general engineering on government buildings. Salary, $5,940 a year. Location, New York, N.Y. Y-7454.

Civil Engineer, graduate, with experience in sanitary and storm work design and construction to act as survey party chief and chief draftsman and assist town engineer in small municipal engineering department. Salary, $5,200-$5,600 a year to start. Location, Connecticut. Y-7477.

Civil or Mechanical Engineer, 35-50, with degree, and at least 10 years' experience, to supervise and direct the design and installation of industrial wet waste disposal systems, and corrective systems for air pollution and dust control. Control the organization, planning, and scheduling of activities for efficient completion of work in accordance with requirements. Make preliminary engineering studies and prepare estimates for use as basis for executing decisions on wet waste disposal or air pollution problems. Follow up on field construction and installation phases until project is in efficient operation. Some traveling. Salary open. Location, New Jersey. Y-7492.

Civil Engineer with B.S. degree and 4 years' experience in technical engineering, and 11 years' professional experience in engineering. Must have demonstrated ability to perform difficult engineering work under only general supervision. Salary, $5,060 a year plus 25% cost of living allowance, making total of $6,325 a year. Location, Alaska. Y-7504.

Resident Engineer with at least 10 years' design and field experience on industrial buildings and process equipment installation. Salary, $8,000 a year. Location, Brooklyn, N.Y. Y-7517.

Junior Photogrammetric Engineer with stereoplotting experience, to operate multiplex or Kelsh Plotting equipment and prepare topographic maps. Salary, $3,600-$4,800 a year. Location, Texas. Y-7520.

Engineers for construction projects. (a) Project engineers, 35-50, who have had considerable experience as construction superintendent, etc., on buildings and heavy construction. (b) Inspectors, mechanical and electrical, 35-45, with at least 5 years' experience on plumbing, heating, water supply, sewage disposal, piping, etc., for large projects. Duration, 6 months to 1 year. Salaries, $8,000-$12,000 a year plus living allowance; transportation paid. Must go single status. Location, North Atlantic area. Y-7522.

Civil Engineering graduate with 5 to 10 years' experience in asphalt and asphalt design; experience should have been in airport construction, road buildings, etc. Salary open, bonus at completion of 1½ year contract. Location, Foreign. Y-7523.

Design Engineers, 35-45, graduates, with at least 10 years' construction design and drafting experience, to supervise design, layout and general drafting work for consulting firm. (c) Highway engineer for general road work and airfield runways. (d) Sanitary engineer for private, municipal and government projects. (e) Architectural engineer with varied building experience. (f) Project engineer, civil, with design, field and administrative engineering experience. Salary, $9,000 a year plus bonus. Location, New York, N.Y. Y-7534.

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Positions Announced

Veterans Administration. Openings for engineers with a college degree in civil, general, mechanical or construction engineering, are now available throughout the country, at a starting salary of $3,410 a year. Interested applicants may contact the Departmental Personnel Officers, Veterans Administration, Washington, D.C., or apply in person at Room 2057, Munitions Building, 20th and Constitution Avenue, N.W., Washington, D.C.

City of Los Angeles. A written examination for positions as sanitary engineering assistant for the City of Los Angeles, at salaries ranging from $395 to $494, will be held on October 25. Candidates must apply in person or by mail to Civil Service, Room 5, City Hall, Los Angeles, Calif., before 5 p.m., October 15, for permission to take the test.

City of Detroit. An examination will be held on October 17 for the position of director of city planning for Detroit, Mich., at a salary of $12,321 to $12,846. Qualified persons should apply to the Detroit Civil Service Commission, Water Board Building, Detroit 26, Mich., by October 10.

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Methods of Finding Peak Flood Flow Correlated

(Continued from page 66)

valid only within the range of assumed values. It will be noted that the solutions arrived at (9,000 and 7,413) are in each case based on use of Curve 1 extended to a region where the equation is not correct. Direct equations, based on his data, may easily be obtained. For the upper reach, the proper equation would be:

$$n_1 = \frac{491}{Q}\sqrt{5.0 - 3.85 \times 10^{[illegible]} Q^2}$$

which is applicable over a full range of the variables.

The two equations given for the upper reach do not intersect at any point and therefore have no common solution. The figure of 9,000 for Q_a given by the author fails to satisfy the equations from which it is said to be derived.

It will be noted that Table II was made up "covering the probable range of discharge." The result obtained was found to be within this range. Trails have been made starting with other assumed values and it has been found that the choice of the "probable range" determines the result. For example, a result of 26,000 cfs has been obtained, instead of Mr. Davison's 18,000, by starting with values of Q ranging from 18,000 to 30,000 cfs.

Any method that would do away with the necessity for assigning values of n would be welcome to the engineering profession. To date, no such method has been found feasible. Indirect methods of determining peak flood flows are continually being refined as the result of investigations being pursued by agencies concerned with the problem. This research shows promise of yielding the dependability which Mr. Davison and all of us hope for.

TATE DALRYMPLE, A. M. ASCE
Chief, Technical Standards Section
Surface Water Branch
U. S. Geological Survey
Washington, D.C.

Solution to problem on page 45

Where welded rails are used, provisions for thorough lateral support are made. The continuous rail then functions as a compressive member, the induced stress reaching as much as 20,000 psi (not excessive for rail steel) under a 100-deg change in temperature. Ordinary track construction is not such as to be effective in holding a track in line under heavy longitudinal thrust.

Applications for Admission to ASCE, August 9–September 6

Applying for Member

Philip Powell Angier, Baton Rouge, La.
Percival Reiger Banister, St. Paul, Minn.
Walter Churchill Bearden, Gulfport, Miss.
Albert Louis Becker, St. Louis, Mo.
Cecil Carey Chapman, Williston, S. C.
John Robert Connor, Oriente, Cuba
Edoardo Contini, Los Angeles, Calif.
George Henry Echols, Knoxville, Tenn.
Nivaldo Maranhao Faria, Parana, Brazil
Gonzalo Fernos Lopez, Santurce, Puerto Rico
Arthur Ingoldsby Flaherty, San Diego, Calif.
Francis Edward Grunsider, Chicago, Ill.
Verner Cyril Hanna, St. Louis, Mo.
Chester Krum Harding, Atlanta, Ga.
John Earl Harrington, Chicago, Ill.
Som Nath Kapur, Denver, Colo.
Louis Daniel Kirshner, Detroit, Mich.
Barry Michael Kostenko, Chicago, Ill.
Percy Clark MacCallum, New York, N. Y.
Paul MacMurray, Philadelphia, Pa.
Kenneth Goodwin McWane, Washington, D. C.
Clem George Merriman, Detroit, Mich.
Solomon Simon Morris, Cape Town, South Africa
Henry Patrick O'Donnell, Irwin, Idaho
David Pirtz, Berkeley, Calif.
Thomas Bodine Powell, Huntington, W. Va.
George Thomas Richards, Jr., Wilmington, Del.
Addison Edward Richmond, Washington, D. C.
Lemmitty Salmenssaari, Helsinki, Finland
Lawson Scott White, London, England
Ralph Oscar Skoog, Topeka, Kans.
Erik Sollid, Denver, Colo.
Rex Marion Whitton, Jefferson City, Mo.
Carl Frederick Vitterberg, New York, N. Y.
Jesse Floyd Zimmerman, Los Alamos, N. Mex.

Applying for Associate Member

Robert Wendell Anderson, Los Angeles, Calif.
Warren Winton Ausland, Portland, Ore.
Ernest Richard Bey, Wilmington, Del.
John Clarkson, Clifton Heights, Pa.
Chester Bernard Collins, Tacoma, Wash.
Nicolas Napoleon Constantinidis, Athens, Greece
Romeo Alfred Falciani, Hammonton, N. J.
Robert Bruce Finlay, Havana, Cuba
Elmer John Clair Fledderjohn, Los Angeles, Calif.
John Adams Geissinger, New York, N. Y.
William Francis Guyer, Indianapolis, Ind.
Benson Guyton, Vicksburg, Miss.
Fateh Ullah Khan, West Pakistan
Bruce Alexander Lamberton, Denver, Colo.
Harry Leibovich, St. Louis, Mo.
Richard Edgar Lindgren, Boise, Idaho
Oswaldo Lourenso, New York, N. Y.
John Frederick Martin, Washington, D. C.
George Byron Massey, Fairfax, Va.
Francis Roger McCloskey, Rome, Italy
Noshir Nowrosjee Mehta, Bombay, India
Adalbert Hillarius Mendis, Ceylon, India
Clarence B. Mitchell, Jr., Wilmington, Del.
Hector Moreno Gomez, Bogota, Colombia
Karl Indraratna Munasinha, Colombo, Ceylon, India
Isadore Nusbaum, San Diego, Calif.
Robert Orein, Topeka, Kans.
Themistocles Nicholas Plearis, Athens, Greece
Eduardo Jose Salcedo Siller, Mexico, D. F.
Kenneth Burton Schroeder, Denver, Colo.
Shou I Tsien, Boston, Mass.
Peter Alexander Skeeles, Orange Free State, South Africa
Jack Nelson Steketee, Toledo, Ohio
Paul John Thompson, Philadelphia, Pa.
Rolf Christian Volle, Oslo, Norway
Michael Anthony Voltno, Long Island City, N. Y.
Wallace-Glenn Williams, Jr., Wilmington, Del.

Applying for Junior Member

Morton Bates Adams, Houston, Tex.
George Peter Anaston, Rochester, Pa.
Ralph Warren Anderson, San Francisco, Calif.
Douglas Hugh Beecham, Los Angeles, Calif.
James Boyce Case, Fort Belvoir, Va.
John James Casey, Minneapolis, Minn.
Albert Martin Greenshealt, St. Louis, Ill.
Ari Hammer, Bolivar, Venezuela
John Walker James, San Andreas, Calif.
Dimitrios Dennis Koutsodimitropoulos, Athens, Greece
Ernesto Mendes Junior, Rio de Janeiro, Brazil
Vladimir Philip William Mohorich, Cleveland, Ohio
Orestis Aristoteles Papageorgiou, Athens, Greece
Charles Williford Pemble, Jr., Lexington, Ky.
Robert Weldon Reynolds, Sacramento, Calif.
Julian Everett Ross, Jr., Ft. Lauderdale, Fla.
Roy John Scown, Jr., Fort Belvoir, Va.
Kyaw Tun, New York, N. Y.
Hilario Velez Barbosa, Rio Piedras, Puerto Rico
Kyaw Win, New York, N. Y.
James Russell Woglom, Pittsburgh, Pa.
William David Wolfe, Jr., Los Angeles, Calif.

Applications for Junior Membership from ASCE Student Chapters are not Listed

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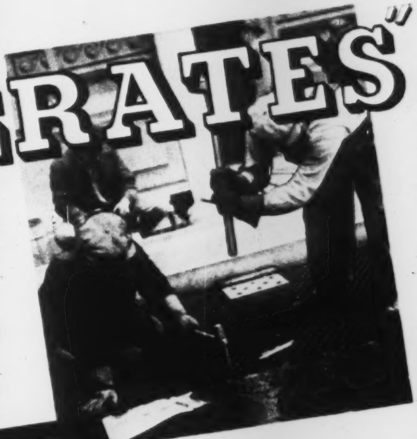

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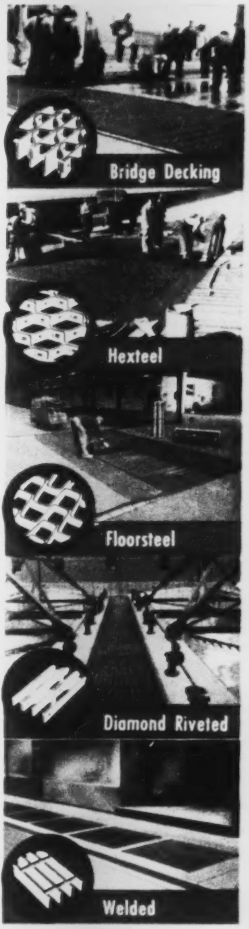

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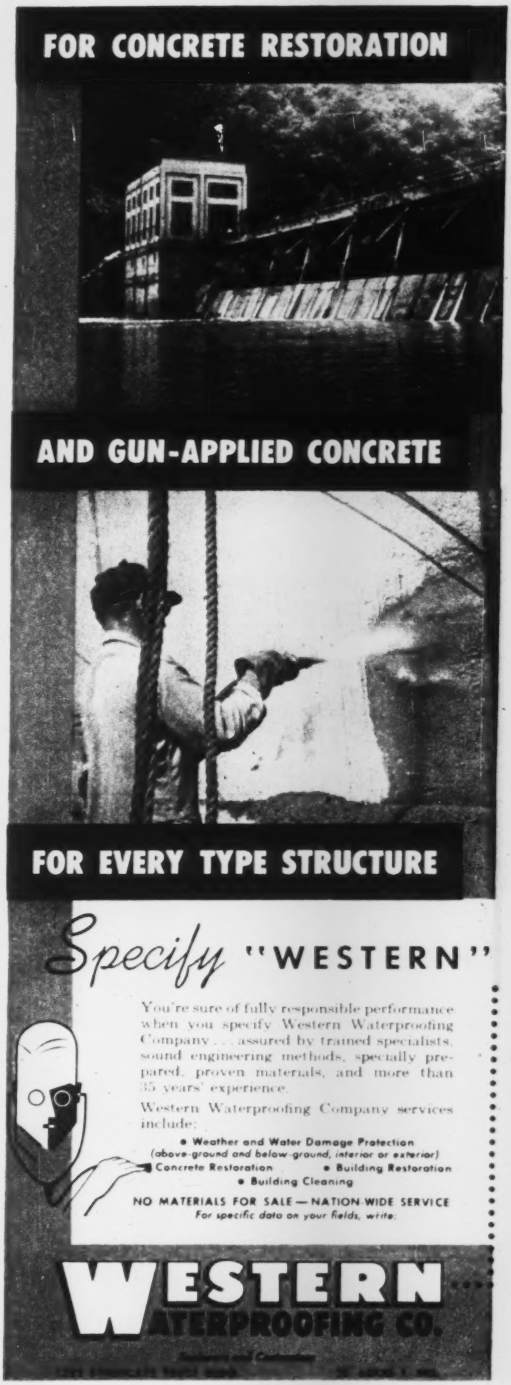

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CATALOG DIGESTS of ENGINEERING and INDUSTRIAL - Interest

1 AERIAL MAPPING

Aero Service Corporation offers catalogs of literature covering its varied aerial mapping services. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning, geological explorations and prospecting for oil or minerals.

2 AERIAL PHOTOGRAPHIC SERVICES

Abrams Aerial Survey Corporation and Abrams Instrument Corporation describe their services in catalogs covering the preparation of aerial surveys and the production of the specialized instruments used in the evaluation and utilization of aerial photographs. The uses and economies of aerial surveys are presented and complete services in aerial photography and aerial mapping are offered, including the production of controlled mosaics and of topographic maps. A complete range of instruments covering all phases of aerial photographic interpretation is shown in a convenient letter size catalog. Instruments shown include stereoscopes of several types, contour finders, height finder, vertical and oblique sketchmasters and mechanical triangulators.

3 AIR-ENTRAINING AGENT

A. C. Horn Company, Inc. has a book on Ayr-Trap, the air entraining agent developed by the Horn company. Information on Ayr-Trap, what it is, what it does, the advantages in mass concrete, advantages in manufactured concrete products, bleeding tests, general conclusions, recommended dosages are also included.

4 AIR-ENTRAINED CONCRETE

Lone Star Cement Corp. A 36-page booklet illustrated with 11 graphs and tables and 86 photographs, contains technical and practical information as to desirable air content, increased durability and resistance to frost action, improved workability, reduced bleeding and easier finishing of concretes made with Lone Star air entraining Portland cement and "Incor" air entraining high early strength Portland cement. Of special value is definitive information for use in designing air-entrained concrete mixes.

5 AUTOMATIC BACKWASH FILTER

Hardinge Company, Inc. has just released a revised Bulletin No. 46-A covering the automatic backwash rapid sand filter. The filter has a compartmented sand bed and a traveling backwash mechanism which cleans one compartment at a time while the rest of the filter bed operates normally. No shut down or change over is necessary for backwashing. The catalog includes recent improvements in the filter as well as new installation pictures and operating data. The following applications are discussed: industrial and municipal water supply, paper mill "white water" recovery, sewage and industrial waste treatment.

6 AUTOMATIC CURING MACHINE

The Flexible Road Joint Machine Co. An 8-page folder on the Flex-Planer automatic curing machine tells what automatic curing means to the engineer and roadbuilder and what automatic curing has accomplished already. Outstanding features, attachments, and on the job photographs are included.

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NOT GOOD AFTER November 15, 1952, for readers in the U.S., but requests will be accepted to December 30, 1952, from readers outside of this country.

7 BITUMINOUS MIX PLANT

Barber-Greene Company. This unusual piece of product literature points to a trend in road building. Much effort has been concentrated on outlining an "idea" for cutting road building costs. Bulletin 848 80-140 TPH capacity gives valuable information on the development of a logical and economical road building and maintenance program. Consisting of eight two-color pages, the bulletin shows drawings and photographs of typical plant set-ups, pictures of operating plants, and extra value components of B-G used in the production of low cost, long lasting roads.

8 BITUMULS—TYPES AND USES

American Bitumuls & Asphalt Company has a 24-page two-color booklet "Bitumuls For Maintenance" which is a fully illustrated, valuable guide to modern methods, materials and equipment for the repair and maintenance of existing pavements. It covers the use of various types of emulsified asphalts with a wide range of aggregates.

9 BLUEPRINT MARKING PENCIL

American Lead Pencil Co. New brilliant colors in the Venus color pencil line for marking on blue or white prints. 54% stronger, sharpens to a sharp needle point and holds it. 27% greater markability, brilliant, clear marking, waterproof too!

10 BOOKS

The Ronald Press Company has a list describing books to help you meet today's requirements in engineering, industry, production and personnel.

11 BORING BIT

Herb J. Hawthorne, Inc. "Blue Demon" rock cutter bits for all formation drilling are described in a 16-page catalog No. 525 including prices and operating information for shot hole drilling, mining exploration, foundation testing and water well drilling. Bits are from 1⅞ in. to 11 in. including AX, BX and NX. Bits are furnished to fit any threaded connection including E, A, B and N rods and 2⅜ in., 2⅞ in. and 3½ in. drill pipe.

12 BORINGS

Raymond Concrete Pile Co. A booklet "Subsoil Investigations for Foundations," catalog B-3, explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

13 BRONZE CASTING ALLOYS

American Manganese Bronze Co. A 50-page edition of the "Reference Book on Bronze Casting Alloys" gives general information on composition, characteristics, and applications of many of the common or typical alloys. The book will help the engineer or designer in the selection of the right alloys for any general application.

14 BUSINESS & TECHNICAL GUIDE

McGraw-Hill Book Co. offers a new 1952 guide to practical, expert information on many business and technical subjects. The catalog contains clear, concise descriptions of more than 2,000 books written by leaders of business, industry and research. In it there is an up-to-date listing of books that give the facts, experience, data needed in solving your particular problems.

There are 180 Digest items on pages numbered 104 to 126. Read all items for the literature of interest to you.

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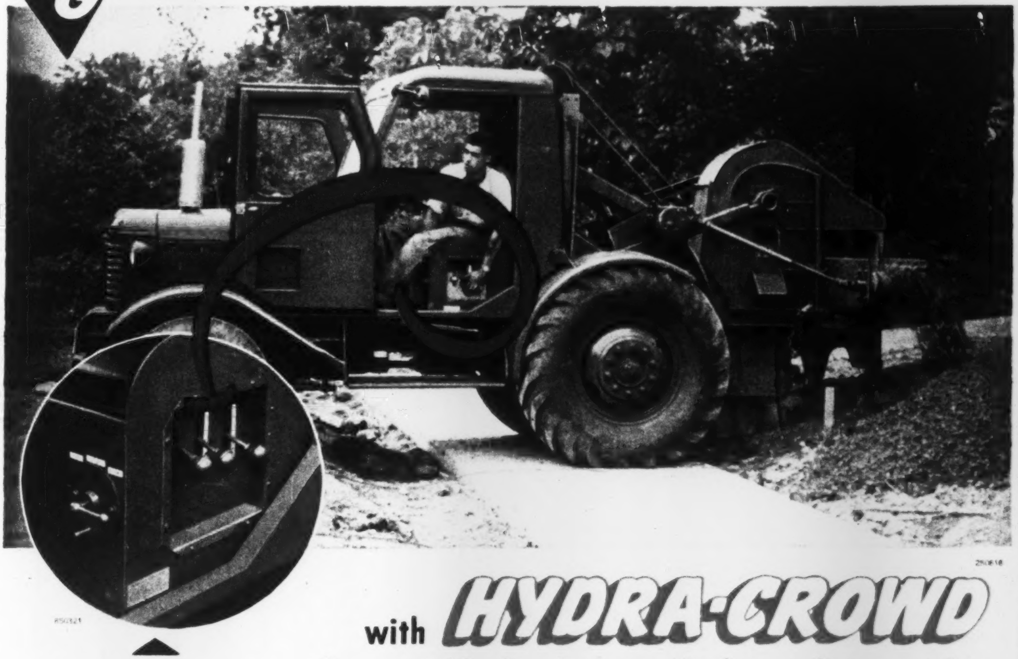

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CATALOG DIGESTS

15 CAST-IN-PLACE PILES

Eastern Concrete Pile Co., Inc. has a folder on COBI cast-in-place concrete piles. It illustrates how the piles are driven, poured and tested. The corrugated spiral shell is driven by a pneumatic mandrel expanded with 125 psi pressure. The company points out that the piles screw themselves into the ground, resisting both settlement and uplift.

16 CAST IRON PIPE

United States Pipe & Foundry Company. An 8-page booklet includes specifications, dimensions and weights for 2-in. and 2¼-in. mechanical joint and bell and spigot joint cast iron pipe and fittings. Pipe is centrifugally cast in metal molds in nominal 12-ft lengths for water, gas, sewerage and industrial service.

17 CAST IRON PIPE

Warren Foundry & Pipe Corp. has a general catalog showing weights, dimensions, description, etc., of bell and spigot, flange, flexible joint and mechanical joint cast iron pipe and fittings together with standard specifications for same.

18 CEMENT GUN

Cement Gun Company, Inc. Of considerable interest to the engineering profession is a 60-page booklet designated as Bulletin 2400 describing the cement gun and its applications. It covers the principal uses of "Gunite" and is profusely illustrated. In the last few pages of this bulletin are typical specifications for various types of "Gunite" work.

19 CEMENT MORTAR LINING

Warren Foundry & Pipe Corp. offers A.S.A. Standard Specification A 21.4–1939 for cement mortar lining for cast iron pipe and fittings.

20 CENTRIFUGAL PIPE

The American Cast Iron Pipe Company manufactures Mono-Cast centrifugal pipe in diameters 3 in. to 48 in., inclusive, with joints for every service condition, including American Double X, molox ball joint, bell and spigot, roll-on joint, threaded and coupled well casing, flanged pipe with screwed-on flanges, and armored pipe. Write for literature stating the kind of joint in which you are interested.

21 CHEM-O-FEEDERS

%Proportioneers, Inc.% Bulletin describes application of chem-o-feeders for chlorine dioxide, hypochlorite, and chemical feeding to municipal and private water supplies, sewerage treatment, and swimming pools. Exclusive "See-Thru" reagent heads permitting visible inspection of all moving parts in contact with chemical solution, corrosion resistance, and ability to operate under high pressure are some of the advantages discussed.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

22 CLARIFIERS

Hardinge Co., Inc. The 12-page equipment Bulletin 35-C gives a complete description and specifications of the Hardinge beam type circular clarifiers, center column type circular clarifiers, and rectangular clarifiers for skimming and sludge collecting. It also describes Hardinge digesters, automatic backwash sand filters, flocculating equipment and Ruggles-Coles rotary dryers. It covers stream pollution problems encountered by practically all industries which have a waste disposal problem.

23 COAL STORAGE

Allis-Chalmers Mfg. Co. has a booklet answering safe coal storage problems. The publication is suited as a training aid on safe, orderly coal handling methods. The most flexible type of equipment, with low operating cost, obtained by a small investment, shows how to store coal without the hazards of fire and oxidation.

24 COMMINUTOR

Worthington Corporation. A 12-page bulletin No. W-2010-B3 describes the Worthington Comminutor used for cutting or shredding coarse solids contained in raw sewage. This bulletin also illustrates the manner in which the Comminutor is easily installed in any existing sewage channel.

25 COMPACTION BROCHURE

Wm. Bros Boiler & Mfg. Co. A 12-page brochure on the history of pneumatic tired compaction equipment has just been released. The first section contains a condensed background of rubber tired compaction developments in the construction of super highways, heavy duty airfield runways and giant earth dams. The second section has results of compaction tests conducted at the Oahe Dam project near Pierre, S. Dak. Also shown are charts describing performance of Bros 35 and 50-ton Roll-O-Pactors in various types of fills. Details and specifications on the Roll-O-Pactor are in the third section.

26 CONCRETE ADMIX

American Bitumuls & Asphalt Company. A 4-page leaflet "Pittsburgh Testing Laboratory Report on Hydropel, An Integral Admix For Waterproofing Concrete" as compared to other admixes is offered. Reproductions of the actual test reports from this independent laboratory, combined with explanatory graphs, charts, photographs and summaries, show the superiority of Hydropel concrete in resistance to water absorption.

27 CONCRETE AIRPORT PAVEMENT

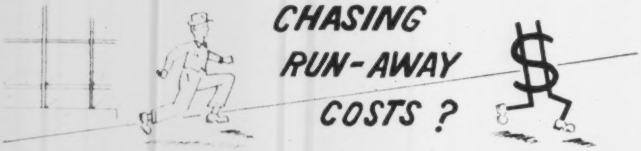
Portland Cement Assoc. The 46-page booklet is a manual of new design procedures for runways, aprons and taxiways made necessary by heavier wheel loads and multiple wheel landing gears. It contains simplified design charts for determining slab thickness under different conditions of service, jointing practices, use of reinforcing steel, subgrade preparation and construction procedures for concrete resurfacing.

28 CONCRETE CRIBBING

Universal Concrete Pipe Co. An 8-page folder deals with concrete cribbing, tells where it is used, its principal advantages, shows typical wall sections, specifications and installation instructions.

29 CONCRETE FACT BOOK

Autolene Lubricants Company. An enlarged edition of the Protex Modern Placement of Concrete Fact book has been recently published. The edition contains the latest technical information and field use tips on air-entrained concrete. Complete with photographs of the latest concrete construction projects, the book is full of question and answer information about air entrainment technique and Protex air-entraining solutions. Many photographs have been included to show actual test pictures of concrete with and without Protex air-entraining solutions.



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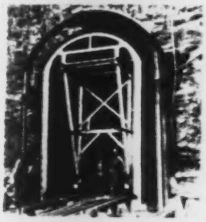

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CITY ____________________ STATE ____________

CATALOG DIGESTS

30 CONCRETE FORMS

Universal Form Clamp Company offers two booklets just released for the interest of those concerned with the Uni-Form panel system and its versatility in building sewage treatment plants (SA-75). Faster, easier and more economically. The second booklet (SA-70) covers the general use of the firm's products, form ties, anchors and other accessories for reinforced concrete construction. Both booklets provide the reader with diagrams, illustrations and actual photographs of operation.

31 CONCRETE JOINT MECHANIZATION

The Flexible Road Joint Machine Company. A 24-page catalog tells the reasons why the dual-plane method of mechanical joint installation is popular with engineers and contractors. There are sections devoted to its practical application, economy in the field, specifications and engineering data, special joint attachments, joint materials, tools and accessories. Also the complete line of concrete construction equipment is shown.

32 CONCRETE PAVEMENT DESIGN

Portland Cement Association. An 80-page edition simplifies and expedites design procedure for roads and streets carrying all classes of traffic. Eighteen pavement design charts have been reduced to four covering a somewhat wider range. This manual for the practicing engineer includes design charts for tiebars and dowels, an expanded section on subbases, two pages of joint details and a simplified procedure for determination of controlling wheel load.

33 CONCRETE PIPE

Lock Joint Pipe Company has a catalog covering the design and manufacture of all types of Lock Joint concrete pressure pipe and a pamphlet giving complete instructions for the installations of all types and sizes of the pipe. Both pamphlets are liberally illustrated with photographs and technical drawings.

34 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association. An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

35 CONCRETE PIPE HANDBOOK

American Concrete Pipe Assoc. A handbook contains 184 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill is presented along with examples and tables. Useful hydraulic data and information on jacking pipe lines is given. A thorough, comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains ASTM and AASHO specifications. Price $1.00.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

36 CONCRETE PRESSURE PIPE

Price Brothers Company. The Big 4 Requirements for Water Line Construction points out how concrete pressure pipe provides long life, sustained high carrying capacity together with great strength. It includes a comparison of the rate of flow in concrete pressure pipe with other type water line materials.

37 CONCRETE REINFORCING DESIGN HANDBOOK

Concrete Reinforcing Steel Institute has a new 432-page manual offering finished design data for every principal type of reinforced concrete building member, already worked out in tabular form. No formulas or calculations needed, just apply load and span requirements to the appropriate table and read off complete data. Indispensable for engineers, designers and architects. Follows current codes and practices. Price is $5.00 per copy postpaid.

N. B. There is a charge for this book. Make checks payable to the Concrete Reinforcing Steel Institute.

38 CONCRETE SAWS

Clipper Manufacturing Company. A series of nine actual case history studies show the many applications of Clipper concrete saws. All of the studies contain information and illustrations which show the advantages of sawing before breaking for patches and trenches and sawing contraction joints. Each study is directed to a particular field of concrete saw use: No. 19 Utility Companies; No. 20 Concrete Contractors; No. 21 Building Contractors; No. 22 Municipalities; No. 23 Sewer, Trenching & Pipe Line Contractors; No. 24 Electrically Powered Concrete Saw; No. 25 Plant Maintenance; No. 26 Paving Contractors (Airfields); No. 29 Paving Contractors (Streets and Highways).

39 CONSTRUCTION DATA HANDBOOK

A. C. Horn Company. A 106-page Horn Construction Data Handbook is offered. Each product is listed as to description, use, covering capacity, color and packaging. Included in the catalog are construction details and many tables and charts on weights and measures.

40 CRANE-EXCAVATORS

Wayne-Crane Div., American Steel Dredge Co., Inc. A catalog illustrating the heavy duty line of [illegible] yd crane-excavators has been published. Numerous features of all three models (crawler, truck and wagon) are shown in this descriptive catalog. These include the deck machinery layout, self-leveling chassis, oversize 20 in. clutches, large modern cab and right angle drive mechanism. Complete specifications and operating data are included.

41 CRANES AND EXCAVATORS

Osgood-General Companies offer Bulletin No. 5226, a condensed catalog presenting the company's line of excavating and materials handling machinery pictorially with condensed specifications. Sizes of machines range from [illegible] to 2 [illegible] cu yd capacity, and from 10 to 60 tons lifting capacity. Choice of mountings and front end attachments is illustrated, as well as special equipment for many varied types of operations.

42 CRUSHING, SCREENING PLANTS

Universal Engineering Corporation, division of Pettibone Mulliken Corporation has issued a well-illustrated general bulletin U-600. This digest covers the complete line of Universal crushing, screening, washing and loading plants for rock, gravel, agline and concrete aggregates. Detailed bulletins of plants and loose units are available upon request.

43 CUSHIONED ALTITUDE CONTROL VALVES

Golden Anderson Valve Specialty Co. A 16-page bulletin fully describing the features of the company's cushioned altitude control valves is available. Featured in this catalog are illustrations, operating sequence and installation arrangements of the various single and double acting altitude control valves. General instructions, parts lists and dimensions are shown along with a special section on maintenance.

44 DRAFTING MACHINE

V & E Manufacturing Co. The Vemco drafting machine repeats on the drafting table the operations of a transit in the field. This enables the engineer to plot directly from field notes any type of surveying data. The drafting machine has all the refinements required by the United States Coastal and Geodetic Survey.

45 DIAMOND BITS

Sprague & Henwood, Inc. Bulletin No. 320 has sixteen large fully illustrated pages containing detailed information regarding a complete line of diamond bits for core drilling, blast hole drilling, etc. Information is given also regarding Sprague & Henwood's modern manufacturing facilities, their complete line of drilling machines and accessory equipment for core drilling and soil sampling, and their world wide business in contract diamond drilling. The latter includes exploratory core drilling, foundation testing, grout hole drilling and pressure grouting.

46 DIESEL CRAWLER TRACTORS

International Harvester Company presents individual product catalogs covering each of the five International industrial diesel crawler tractors, TD-6, TD-9, TD-14A, TD-18A and TD-24. Two of the above models are also available with carbureted engines, T-6 and T-9. A special catalog illustrating crawler tractors in pipe line operations can be obtained upon request.

47 DIESEL POWER UNITS

International Harvester Company. Information on six models of International diesel power units, the UD-6A, the UD-9A, UD-14A, UD-16A, UD-18A and UD-24, is contained in a catalog entitled "International Diesel Engines and Power Units." A second catalog entitled "International Gas, Gasoline or Distillate Engines and Power Units" covers the five International carbureted power units, U-1, U-2A, U-4, U-6, and U-9. Also available is a catalog illustrating International power units in oil field pumping operations.

48 DOCKS, WARFS AND PIERS

De Long Engineering & Construction Co. Brochure describes the fabricating, towing and erecting operation of the De Long dock. This steel dock fabricated in efficiently operated fabricating or ship building plants or yards in various parts of the world and towed to site of final location is erected in a matter of several days ready for berthing ocean going ships. Permanent or temporary erections. Brochure illustrates installations of 50 ft by 1000 ft dock for army north of arctic circle and permanent 82 ft by 1130 ore and cargo handling dock on Orinoco River, Venezuela.

49 DOORS

The Kinnear Manufacturing Co. The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features and the general specifications of the various types of wood and steel upward acting type doors. Known as Bulletin 72, it gives information on installation, clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

50 DRAWING INSTRUMENTS

Henry Wild Surveying Instruments Supply Co. of America, Inc. An illustrated booklet describes the fine features of the new Wild drawing sets. Made from solid stainless steel, they resist oxidation and wear much better than instruments made from brass or German silver. Complete sets in metal cases, as well as single instruments are available. The blades of drawing pens are hardened and have a knife point for easy cleaning.

51 DRAWING PENCILS

The Eagle Pencil Company offers free, a Turquoise drawing pencil with new 100 percent electronic graphite lead. Please specify degree of hardness desired.

52 DREDGES

Yuba Manufacturing Company has prepared a 42-page booklet describing Yuba bucket line dredges and their use in the placer mining and excavating industries. A copy of the booklet will be mailed upon request and extra copies will be furnished to libraries and universities particularly interested.

NOW...

more translucent than before

Today's Kodagraph Reproduction Cloths have a new, highly translucent base—*an important new plus in drawing reproduction!* For now you can turn out blueprints and direct-process prints at faster speeds . . . save time and money. And famous Kodak research and production know-how brings you this increased translucency without compromise—your Kodagraph Cloth intermediates will be as durable and long-lasting as ever.

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The dense photographic black images on Kodagraph Reproduction Cloth prints can be removed readily with a moistened pencil eraser—no special solutions needed. And after deletions have been made—you'll find that additions are easy to make with a pen and regular drafting ink. Thus . . . Kodagraph Reproduction Cloths fully meet the needs of the drafting room just as they do those of the print-making department.

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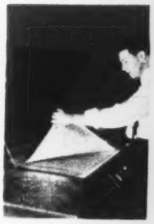

2. Kodagraph Contact Cloth—for use in low-intensity contact printers. Conventional negative-positive printing characteristics . . . darkroom handling. Especially recommended when your negatives require considerable opaquing or other hand work.

3. Kodagraph Projection Cloth—for use in standard enlarging equipment. Conventional negative-positive printing characteristics . . . darkroom handling. Especially valuable in obtaining reference-size prints from reduced-scale negatives of template or pattern drawings.

Write today for a free copy of "Modern Drawing and Document Reproduction." Detailed facts on improved Kodagraph Reproduction Cloths . . . and the complete line of Kodagraph Reproduction Materials which you, or your local blueprinter, can process *conveniently, economically.*

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Industrial Photographic Division, Rochester 4, N. Y.

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CATALOG DIGESTS

53 ECHO DEPTH RECORDER

Bludworth Marine, Div of National-Simplex-Bludworth, Inc. A specification sheet describing Model ES-123 Supersonic Echo Depth Recorder is offered. This instrument provides a permanently recorded graph of underwater contours as well as an indication of the consistency of bottom materials. Underwater survey groups, dredging companies, bridge builders and underwater pipeline companies will find this equipment most interesting.

54 EFFECTS OF CALCIUM CHLORIDE

Solvay Sales Div., Allied Chemical & Dye Corp. has prepared a 40-page semi-technical booklet of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.

55 ELECTRIC DATA ON SEWAGE

General Electric Company. An application data manual intended to explain processing requirement of sewage treatments and to serve as a guide for applications of electric apparatus and system engineered equipments. Does not include problems of a general nature, although references are made to publications dealing with them. Listed as Bulletin GET 1343.

56 ELECTRIC FISH SCREEN

Electric Fish Screen Corporation. An illustrated pamphlet describes a modern method of keeping fish of all sizes at a safe distance from travelling screens or grids in condensing water intakes, hydroelectric plants, water systems and industrial pumping installations. It eliminates expensive maintenance problem of cleaning clogged intakes during excessive runs of fish or eels. Electronic equipment generates special electrical pulses energizing electrode system, often utilizing existing screens or trash racks. It is simple and economical to install and maintain.

57 ENGINEERING BOOKS

Frederick Ungar Publishing Co. Circulars sent on request describe important books on structural engineering, including the famous books by A. Kleinlogel "Rigid Frame Formulas," "Influences on Concrete," etc., in English and in German. Many time saving helps for engineers in books on prestressed concrete, influence line tables, solutions of fixed end moments for rigid frames and continuous beams, etc. This firm also publishes bilingual dictionaries.

58 ENGINEERING INSTRUMENTS

W. & L. E. Gurley. An illustrated 64-page catalog, No. 50, describes the complete line of Gurley's engineering instruments. Description and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories are listed. Dip needle, cruising and geologists compasses are included, as well as current meters, water level recorders and wind instruments.

59 ENGINEERING INSTRUMENTS

National Blue Print Company has a booklet discussing their instrument repair shop where they are prepared to repair, rebuild and refinish optical reading measuring instruments of nationally known makes and models such as W. & L. E. Gurley, Brunson Instrument Co. and David White Co. The company also sells rebuilt transits and levels that have been completely reconditioned.

60 EQUIPMENT

Austin-Western Company. A 12-page catalog, AD-2146, covering the company's line of equipment is available. This includes descriptions and pictures of the various sizes of power graders and their attachments, street sweepers, 3-wheeled and tandem rollers, the Badger convertible shovel and the complete line of crushing, screening and washing equipment.

61 EXCAVATORS

Bucyrus-Erie Co. A two color 32-page booklet "Ways to Make Your Excavator Work Harder, Live Longer," gives helpful tips on operation, maintenance and safety as they apply to shovels, draglines, dragshovels, clamshell and lifting cranes. The booklet is attractively illustrated by means of photographs, drawings and cartoons.

When filling out the coupon, please print your name, address, and business affiliation clearly. Request only the items of particular interest to you. Be sure to enclose checks when requesting charge items.

A modern barrel makes an old Mathews Hydrant good as new

• Many a Mathews Hydrant has been in service for several generations. When the time comes to modernize, it is a simple matter to remove the old barrel and replace it with a modern one. It is unscrewed from the elbow, then withdrawn through the protection case and a new barrel inserted in its place. The job is done in a few minutes—*without digging or breaking the pavement.*

MATHEWS
HYDRANTS
Made by R. D. Wood Company
Public Ledger Building, Independence Square
Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Mathews Modernized Hydrants . . . Tops in Convenience and Dependability

Compression type valve prevents flooding • Head turns 360° • Replaceable head • Nozzle sections easily changed • Nozzle sections easily raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be lubricated • All working parts contained in removable barrel • Available with mechanical-joint pipe connections

CATALOG DIGESTS

62 FIBRE FORMS

Sonoco Products Company. A 4-page brochure which describes the use of fiber forms for round concrete columns is offered. It also illustrates many different uses and gives sizes of the forms.

63 FIELD, LEVEL, AND TRANSIT BOOKS

Wilson Jones Co. has a circular describing a broad line of field, level, transit, topographical and cross section books. Forms are lithographed on water repellent paper. There are loose leaf and bound book styles. Ask for Circular D-1115.

64 FILTER PLANT GAUGES

Simplex Valve & Meter Co. A complete description of the Simplex filter plant gauges is contained in Bulletin No. 1000. This contains illustrations and dimensional data on the many forms of gauges used in filter plants such as rate of flow, loss of head, elevation, wash water and sand expansion units. This bulletin should be a part of the engineer's catalog file.

65 FLAT BASE PIPE

The Universal Concrete Pipe Co. has a folder on flat-base pipe which is available in a wide variety of standard sizes. Flat base pipe simplifies construction of culverts, pedestrian underpasses and cattlepasses, utility galleries and manholes. Advantages are listed, construction details and illustrations are included.

66 FLOODLIGHTING PLANS

General Electric Company. NEMA authorized engineering information. Designated as bulletin GET-1284C, the publication includes complete layouts and specifications for all types of recreational facilities, including lighting diagrams for swimming pools, tennis, baseball, golf-driving ranges, racetracks, and the like.

67 FLOOR GRATINGS

Borden Metal Products Co. A catalog containing technical information on how to select, design, purchase and install floor gratings, safety steps, floor armor is offered. Safeload tables, step-by-step procedure for ordering, planning and checking, etc., is included.

68 FLOORSTEEL CATALOG

Klemp Metal Grating Corporation—A 4-page catalog entitled "Klemp Floorsteel, the flexible floor armor that rolls out like a rug", describes and illustrates the manufacturing, shipping and laying of this patented industrial flooring reinforcement mesh. Klemp Floorsteel is widely used in the construction of new floors or in the repairing of old floors both wooden and concrete. Catalog describes and shows six typical flooring installations.

69 FLUORIDATION

Proportioneers, Inc.—Bulletin SAN-9 gives the complete story on the feeding of fluorides for the reduction of dental caries. It explains the methods of feeding sodium silico-fluoride and hydrofluoric acid under pressure. Special attention is given to the accurate control of feeding in strict proportion to the flow. Equipment is described for feeding into pressure line.

When ordering literature for which there is a charge, please make checks payable to the company offering the material!

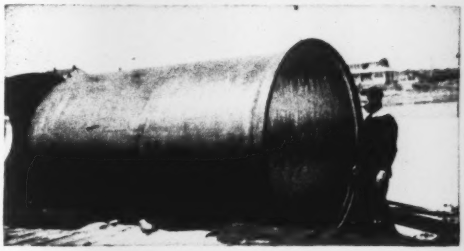
70 FOUNDATIONS

Drilled-In Caisson Corporation. Literature describes foundation columns anchored in rock sockets, heavy column loads carried on single caissons, penetration through any type of soil to rock at any depth, examination of rock can be made, economy in time and labor, foundation bonded in rock, description, design, specifications, technical data.

71 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc. Literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations, Pretest foundations, caissons, foundations under existing buildings, shoring and moving buildings.

This is worth looking into



We make CAST IRON PIPE . . . built to last for generations . . . in any size from 2" to 84" with all types of joints. For 96 years, the WF trade mark has meant "durable pipe" . . . made with proper crushing, beam, shock and bursting properties.

It's the kind of pipe that stays in service . . . rugged, strong . . . economical because you can bury it and forget it! Miles upon miles have been underground for almost a century and *still* in good condition when excavated.

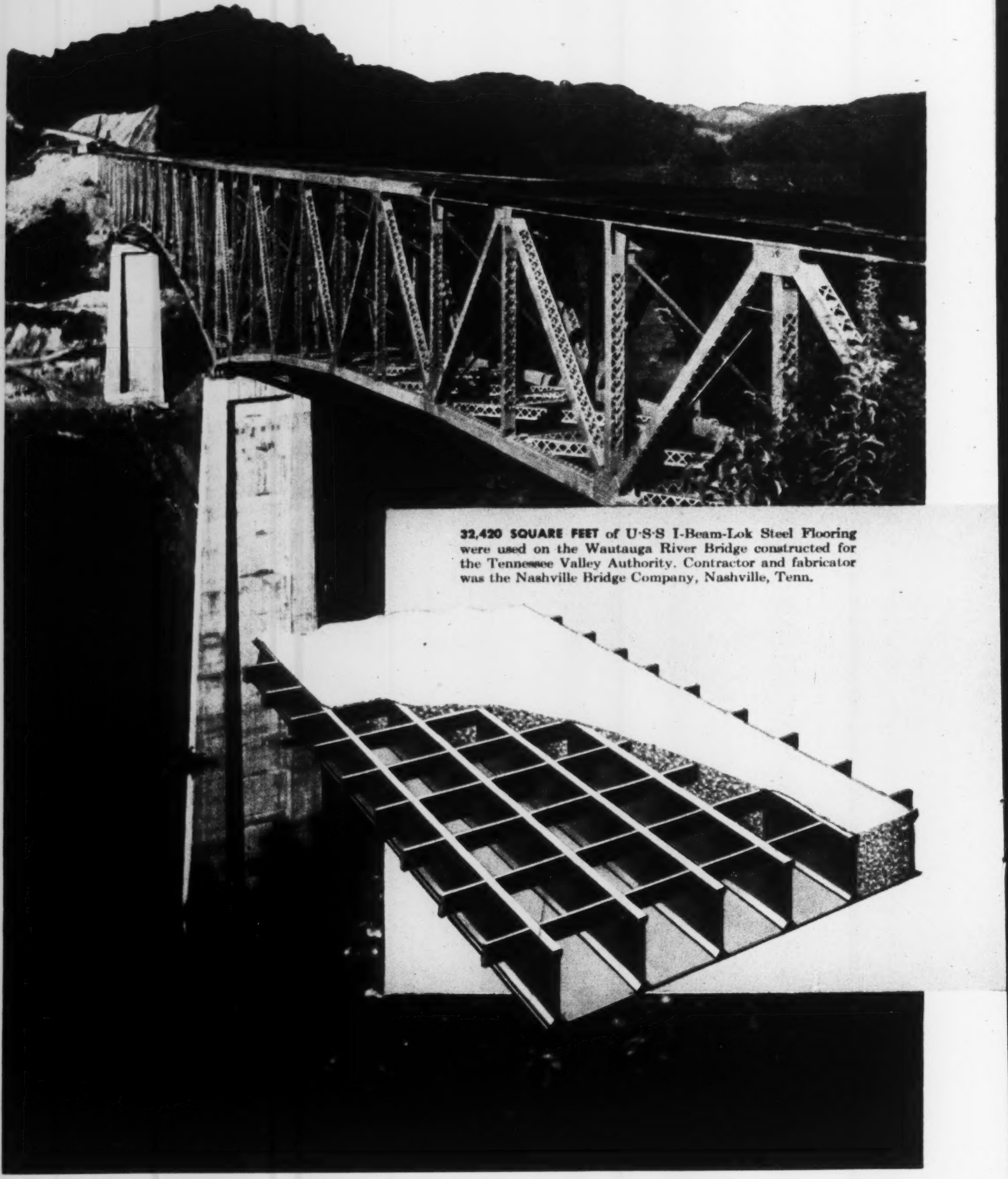
Bell & Spigot Pipe
Flange Pipe
Flexible Joint Pipe
Cast Iron Rolls
Cylinders
Special Castings
Short Body Bell & Spigot Specials

Specify WARREN CAST IRON PIPE . . . AND BE SURE!

Also manufacturers of special castings in medium and heavy weight Alloy Iron, Grey Iron and Meehanite Iron for special purposes. Catalogs and Brochures available.

Warren FOUNDRY & PIPE CORP.
55 LIBERTY STREET, NEW YORK 5, N. Y.
PLANTS: Phillipsburg, N. J. Everett, Mass.
WARREN PIPE CO. OF MASS. INC. 75 FEDERAL ST. BOSTON, MASS.
96 Years of Continuous Service

U·S·S I-Beam-Lok Steel Flooring



32,420 SQUARE FEET of U·S·S I-Beam-Lok Steel Flooring were used on the Wautauga River Bridge constructed for the Tennessee Valley Authority. Contractor and fabricator was the Nashville Bridge Company, Nashville, Tenn.

reduced floor weight 42%

ON WAUTAUGA RIVER BRIDGE

By using U·S·S I-Beam-Lok Steel Flooring on this bridge over the Wautauga River, the Tennessee Valley Authority was able to cut the weight of the bridge floor nearly in half and realize substantial savings in structural members. In addition, the speedy construction resulting from the use of this flooring enabled TVA to open the highway to the dam site sooner.

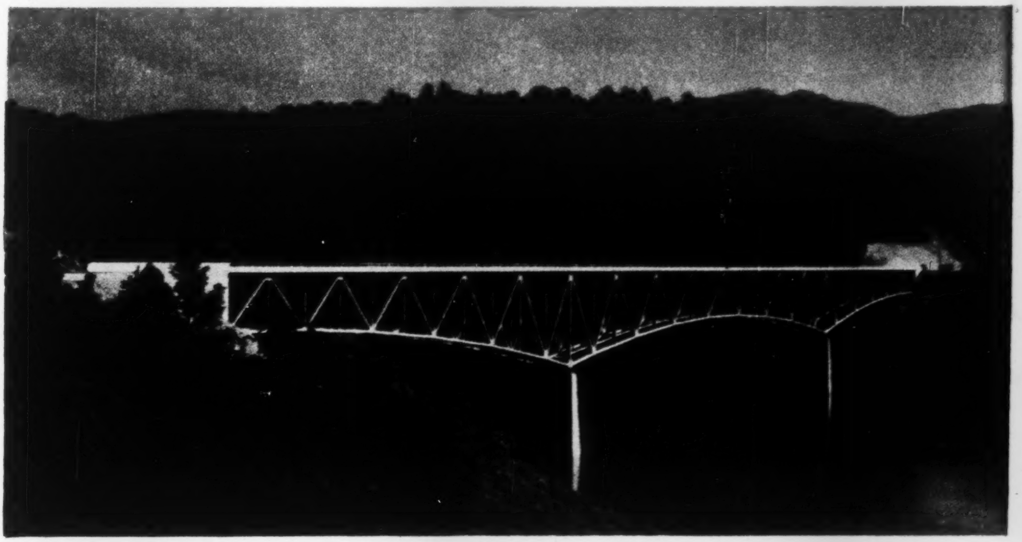
TVA specified 3″ concrete-filled U·S·S I-Beam-Lok with ¼″ concrete overfill for the job, and the approximate weight of the 32,420 square feet required was 1,601,540 pounds. Had 7″ concrete been used the floor weight would have been about 2,755,700 pounds. Use of U·S·S I-Beam-Lok thus saved 1,154,160 pounds, or about 42% of the weight of the floor with 7″ concrete construction.

Concrete-filled type U·S·S I-Beam-Lok Steel Flooring provides a smooth-riding, safe, fireproof and long-life surface.

By reducing the weight on the supporting structure, this type of flooring permits use of smaller stringers, floor beams, trusses and piers. U·S·S I-Beam-Lok is delivered completely shop fabricated and no concrete forms are necessary.

In addition to the concrete-filled type, U·S·S I-Beam-Lok Steel Flooring is available in open-type weighing as little as 18.8 lbs. sq. ft.

Get full information on these "modern floors for modern traffic." Our engineers will be glad to discuss their possibilities with you.



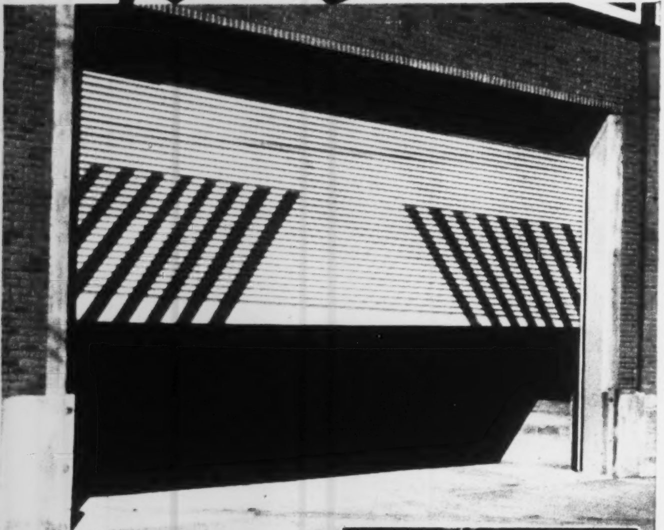
UNITED STATES STEEL COMPANY, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S I-BEAM-LOK

2-1445

UNITED STATES STEEL

KINNEAR
Rolling Doors



CONTINENTAL

Greater Efficiency
SAVES
Time, Space, and Money

Every Kinnear Door is tailored to fit the individual opening, in old or new buildings. Coiling neatly above the lintel, they open straight up — can't interfere with traffic or other plant activity. A half-century of use under the most difficult conditions gives complete proof of the Kinnear Door's capacity for years of hard, constant service.

They save money because their rugged, all-steel, interlocking slat curtain assures long life and low maintenance costs, plus *extra* protection against fire, intrusion, or wind damage. Slat surfaces are heavily zinc coated by the hot-dip process, and a special Kinnear Paint Bond is applied to assure lasting paint adhesion.

They save space by opening straight up and coiling above the doorway, allowing all floor and wall space around the door to be used at all times.

They save time with their smooth, easy, gliding action. With motor operation, doors can be fully and safely controlled by push-buttons from any number of convenient locations.

Write for your copy of new catalog.

The KINNEAR Manufacturing Company

FACTORIES
1080-90 Fields Ave.,
Columbus 16, Ohio
1724 Yosemite Ave.,
San Francisco 24, Calif.
Offices and Agents in Principal Cities

Saving Ways in Doorways
KINNEAR
ROLLING DOORS

CATALOG DIGESTS

72 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc. Catalog F-225 contains illustrations, descriptions and engineering data on grating flooring, treads and floor armoring (riveted, press-locked, welded types; safe, durable, fireproof, ventilating, clean and economical) for industrial and power plant and refinery walkways, stairways, driveways, trucking aisles, ship cat walks and engine room floors and treads, locomotive, freight and passenger car runways and treads, roadway armoring, expansion joints, catch basin covers, bridge decking.

73 GRAVITY FILTERS

The Permutit Company. A 24-page booklet of interest to all engineers dealing with water problems describes the various types of gravity filters and accessories as well as the new Monocrete underdrain which is inexpensive, easily constructed and non-corrodible. The booklet gives specifications, operating characteristics, outline dimensions and installation photographs.

74 GUNITE

Pressure Concrete Company has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories, and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and much other data.

75 HEAVY CONSTRUCTION

Foley Brothers, Inc. A book entitled "Seventy Years: The Foley Saga" with 194 pages presents an interesting history of Foley Brothers, Inc. since its conception. The book illustrates and describes many of the important projects successfully executed by the company.

76 HEAVY CONSTRUCTION

Foley Brothers, Inc. A 30-page brochure briefing the history and accomplishments of the company over a period of more than 75 years in heavy construction is offered. Individual pages in this looseleaf brochure pictorially represent characteristic projects encompassing almost every phase of heavy construction known to the industry. From time to time supplemental sheets are added covering current projects, and one is now on the press to illustrate an unusual type of service offered by Foley Brothers, Inc., in which reconnaissance, field engineering and construction are closely tied together in certain characteristic works wherein this continuity is of mutual advantage to the owner and the constructor.

77 HEAVY EQUIPMENT

Hyster Company. A comprehensive guide illustrating the use of tractor mounted tools in all basic industries such as railroading, construction, light and heavy logging, farming, mining, oil and gas and governmental projects had been released. Printed in four colors, the brochure uses a unique cartoon style which effectively presents for the first time in one package many of the principle uses for this type of equipment.

78 THE HORTONSPHERE

Chicago Bridge & Iron Company has recently issued an 8-page booklet "The Hortonsphere." This booklet describes the advantages of storing highly volatile liquids and gases in Hortonspheres under pressure. Tables of sizes are included in the booklet. Hortonspheres for the storage of liquids range in capacity from 1,000 to 30,000 bbls. for operating pressures of about 30 to 215 lbs per sq in. Hortonspheres for gas storage have been designed in standard sizes from 32 to 80 ft in diameter for operating pressures of 30 to 150 lbs per sq in.

Please remember industrial literature is costly. It is requested that you ask only for those booklets of particular interest to you.

CATALOG DIGESTS

79 HOT PROCESS WATER SOFTENERS

Permutit Co. Bulletin 2341 illustrates and describes new hot process water softeners. This equipment is especially designed to condition boiler feedwater so as to protect tubes and drums against scale and corrosion and inhibit caustic embrittlement.

80 HYDRANTS AND GATE VALVES

R. D. Wood Co. A 22 page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel containing all the working parts, to the completely revolving head and to the Sand Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

81 HYDROLOGIC DATA BOOK

Leupold & Stevens Instruments, Inc. A completely revised edition puts interpretive data on water measurement and control at your fingertips. Over 150 plates contain information on float wells and instrument shelters, typical installations, a wealth of hydraulic and conversion tables, and information on internationally famous Stevens water measuring instruments. Price is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc.

82 INDUSTRIAL PRODUCTS

Johns-Manville The 40 page catalog contains descriptions, sizes, illustrations, and application data on the following J-M products: "Transite" asbestos-cement pipe, friction materials, packings and gaskets, refractory products, electrical products, asbestos products and industrial building materials.

83 JOINT FILLERS AND SEALS

Servicised Products Corporation A new and completely revised catalog gives complete details and specifications on joint fillers, hot poured Para Plastic sealing compound, premolded Para Plastic, molded rubber waterstops, corrugated closure strips, sewer joint seals, rail filler, Calk-Crete sealing compound, and safety stair treads.

84 JOINT PIPE AND FITTINGS

Warren Foundry & Pipe Corp A pamphlet "Standardized Mechanical Joint Cast Iron Pipe and Fittings" illustrates mechanical joint pipe and fittings complete with dimensions, weight, etc.

85 LETTERING MACHINE

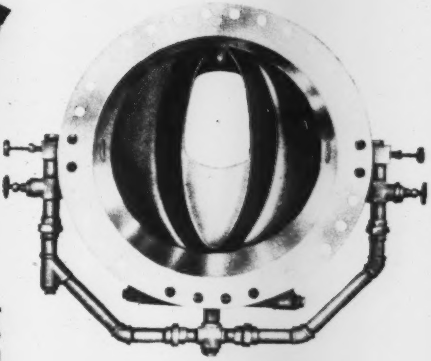
Ralph C. Coxhead Corporation The Vari-Typer engineering lettering machine relieves draftsman from tedious hand lettering. The machine operates like a typewriter but has instantly changeable type faces in different styles and sizes to meet the various needs of the tracing or bill of material. The carriage is designed to hold tracings as much as 6 ft or more in width. The type impressions are electrically controlled producing a uniform, sharp, black character so important to a good tracing. Mathematical symbols as well as draftsmen style lettering is available in the changeable type for cartridge.

86 MECHANICAL PIPE JOINTS

R. D. Wood Co. A 4 page leaflet describes mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high pressure lines for oil, gas, water, steam, or chemicals.

87 METAL GRATING

Klemp Metal Grating Corp. A 4 page catalog entitled, "Klemp 4 Grates Serving the Nation's Major Oil Companies", describes the construction of Klemp-Krest welded grating which incorporates a crested cross bar between the bearing bars to provide maximum non-slip characteristics. Catalog contains technical information including engineer's diagrams, a safe load table on their welded and diamond riveted grating, and a detailed diagram on the installation of their two patented products, Hexteel and Floorsteel, for ganister linings.



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Here's a new concept in venturi design. A venturi tube with an elliptical throat developed by Simplex specifically to solve the problem of accurate measurement of low-velocity sewage, sludge, or trade wastes . . . even under low-pressure conditions.

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For further information, write to Simplex Valve & Meter Company, 6724 Upland Street, Philadelphia 42, Pennsylvania.

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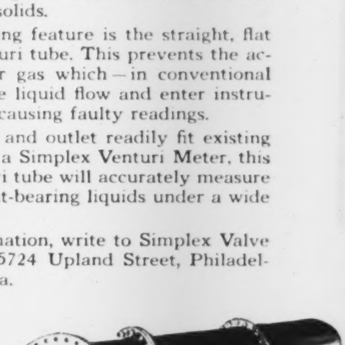

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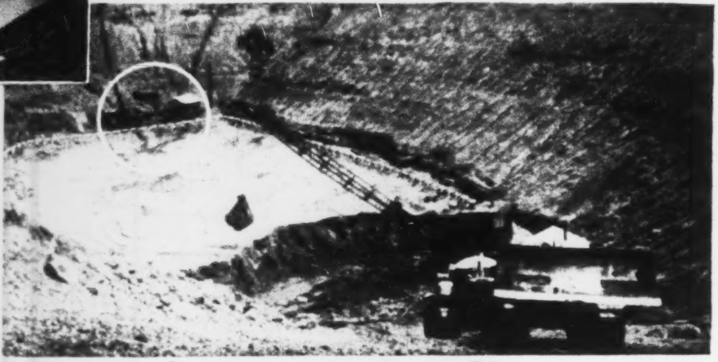
VALVE AND METER COMPANY

STANG DEWATERS 65′ DEEP 300′ x 400′ EXCAVATION FOR LIMESTONE MINE

Above: Flooded excavation of shaft for limestone mine, prior to installation of Sand Piles and Stang Wellpoints.



Digging dry river sand predrained by Stang Wellpoints.

After heavy rain and snow, the [illegible] excavation [illegible] deep, for the [illegible] Lime Company, [illegible] the ground water table rose. Stang engineers recommended [illegible] piles to drain water vertically down to the [illegible] layer [illegible] lying just above the limestone. When the upper banks had been successfully stabilized, Stang Wellpoints were installed on top of the river sand, speedily dewatering it so that final excavation could proceed in the dry. Specially designed [illegible] wellpoints were used [illegible]

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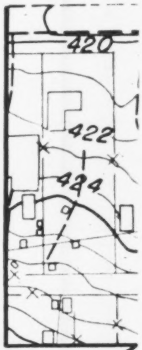

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CATALOG DIGESTS

88 MINE SHAFT AND INCLINE HOISTS

Superior-Lidgerwood-Mundy Corporation. Bulletin M-515 describes and illustrates a full range of steam, electric, gasoline and diesel powered hoisting machinery—engineered and designed to suit—yet consisting of standard parts. They are for use in mines, steel works, industrial plants and engineering and contracting projects. Also hoists for special purposes. Sixteen pages include 36 illustrations of important installations, data required for estimating on mine shaft and incline hoists, general information on mine hoists and hoists for shafts and slopes.

89 MOTOR GRADER

Allis-Chalmers Mfg. Co. A 20-page color catalog presents the 34.7 hp model D motor grader. This low-priced 8,500-lb motor grader has such popular features as tandem rear wheel drive, tubular frame and rear mounted engine transmission for improved visibility.

90 MOTOR GRADER

The Galion Iron Works and Mfg. Co. Catalog No. 375 on the Model 118 motor grader is available. Time-proved features are listed and a construction detail chart, sections on the Galion constant mesh transmission and accessories and attachments are included.

91 MOTOR SWEEPER

Austin-Western Co. An 8-page catalog, AD-2042, pictures and describes the Model 40 motor sweeper with its unique direct broom-to-hopper sweeping which makes unnecessary the conventional belt conveyor or squeegee elevator. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in the catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

92 OPEN STEEL FLOOR GRATING

A. O. Smith Corp. An 8-page booklet, "A. O. Smith Open Steel Floor Grating and Stair Treads," gives concise and complete information on the exclusive 100 percent serrated surface grating for flooring, walkways and stair treads. It is illustrated and includes a grating selection table for uniform or concentrated loads. Comprehensive detail on use of various types of serrated and smooth grating explains advantages over conventional types.

93 OPTICAL POLAR PLANIMETER

Trans-Global Company. An 8-page catalog on the Model 236 optical polar planimeter describes the patent optical tracing ring, zero-setting lever and enclosed wheel carriage. It discusses planimeter theory with formulas and sample calculations and describes compensating positions, internal pole methods, and use of checking gauge. It gives constructional details, specifications, hints for planimeter care and use. Catalog PL-1 is illustrated with photos, diagrams and useful reference tables.

94 OUTDOOR LIGHTING

General Electric Co. Bulletin GEA-3640D, "Outdoor Lighting for Industrial Plants," contains many helpful suggestions for properly lighting plants. Adequate lighting of roadways, loading platforms, parking areas and property lines can easily be obtained with the luminaires and floodlights described.

95 PAVING TREATMENTS

American Bitumuls & Asphalt Company. A 28-page two-color booklet describes in fully scenic photographic form and with basic tabular data the newest practice in step-by-step construction of surface treatments, armorcoats and penetration pavements with Bitumuls emulsified asphalt.

96 PENCIL SKETCHING

American Lead Pencil Co. 24 pages of helpful illustrated instructions on pencil sketching. Only 25¢ with two free Venus drawing pencils.

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Write for new, illustrated Catalog C

The Sauerman cableway bucket dumps its load of gravel and boulders at a narrow point in the river gorge to form a cofferdam. It dumps automatically when its dumping mechanism reaches a stop button attached to the track cable. Then the empty bucket is carried back by gravity to dig another load.

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CATALOG DIGESTS

97 PHOTO-COPIER

F. G. Ludwig Associates. The uses and operation of Contoura portable photo-copiers are explained in a folder. The Contoura provides a simple means of making copies of research material. It is designed to photograph curved pages in tightly bound books without loss of readability. The Contoura operates from an ordinary A.C. or D.C. outlet and requires only a 10-sec exposure. Instructions are given for making prints at home.

98 PHOTOGRAMMETRIC ENGINEERS

Jack Ammann. Air photography, topographic maps, mosaics, planimetric maps, regional maps and all phases of photogrammetric mapping and surveying has been very successfully conducted by this firm for over 21 years as verified by their use by civil engineers, consulting engineers, city planning commissions, oil and gas companies, mining companies, public utilities and commercial industries from coast to coast. The brochure, "Air Speeds to Your Map Needs," which illustrates the modern equipment and techniques used, has become a part of many reference libraries of schools and colleges.

99 PILES

Raymond Concrete Pile Company. Raymond Standard and Step-Tapered Piles are described in literature which also includes information on the scope of Raymond's activities which cover every recognized type of pile foundation including cast-in-place concrete, precast concrete, composite wood and concrete, steel pipe and wood. Raymond's activities and experience also include the construction of caissons and construction involving shore protection, shipbuilding facilities and harbor and river developments.

100 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co. has just published a catalog, No. 81, containing descriptive information, engineering and test data on Monotube steel piles. It also includes numerous photos showing a wide range of job applications in various parts of the country. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile driving equipment without use of driving core or mandrel. Advantages listed: light weight, easy handling, speedy driving, economical field extensibility, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

101 PIPE CEMENT LINING

Centriline Corp. A booklet describes the method of reconditioning pipe lines in place by placing a cement mortar lining on the inside surface which will stop leaks, corrosion and increases flow coefficients. This work can be done in pipe diameters from 4 in. to 144 in. with a minimum interruption of service.

102 PIPE GUIDE

Naylor Pipe Company. Bulletin No. 507 presents specifications on light weight pipe, standard fittings, flanges and connections in sizes from 4 in. to 30 in. in diameter for specified service in construction, dredging, materials handling, mining, oil, paper, power plant and sewage disposal fields.

103 PIPE LININGS

Pipe Linings, Inc. "Tate Process," a 10-page illustrated multicolor bulletin covers a method of lining smaller diameter water, oil, or gas pipe lines "in place." The service cleans corroded matter and tubercules from pipe walls and applies smooth cement mortar lining.

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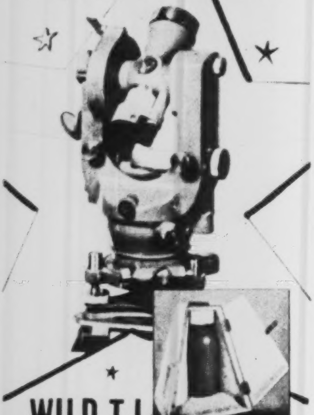

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CATALOG DIGESTS

104 PIPE SYSTEMS

Albert Pipe Supply Co., Inc. An 8-page illustrated brochure describes "packaged" pipe line for temporary and semi-permanent air, gas and water lines, with emphasis on its use for civilian defense. The system is lightweight, portable, easily assembled and available for prompt shipment. It includes pipe, couplings, fittings, adapters and valves where necessary.

105 PIT CAST PIPE

Warren Foundry & Pipe Corp. offers A.S.A. Standard specifications for pit cast pipe for water and other liquids. Specification A 21.2–1939.

106 POCKET INSTRUMENTS

Keuffel & Esser Co. A leaflet entitled "Right Angles with Pocket Instruments" will be of interest to engineers, builders, etc. Such instruments as the right angle prism, the right angle mirror and the double right angle prism are described, and figures and illustrations show how the instruments are used.

107 POCKET TRANSIT

Wm. Ainsworth & Sons, Inc. A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by an instrument weighing only 8½ ozs.

108 PORTABLE BELT CONVEYOR

Barber-Greene Company. Flexibility of performance is emphasized in the Model 363 portable belt conveyors. Specifications and applications of the 363's, which are made in lengths of 25, 30 and 35 ft with plain or cleated belts, are outlined in Bulletin 363. Two pages of sketches in the 8-page bulletin illustrate suggested applications for these conveyors and show how they can be adapted to various conditions to cut costs in handling bulk material of all types.

109 PORTABLE CONVEYOR

Barber-Greene Company. High capacity and flexibility in the heavy-duty portable conveyor are among several features listed in the two-color, 8-page Bulletin 374. Construction features, operating advantages and accessories such as feeders, screens, hoppers, etc., are depicted. Two pages of sketches illustrate uses and advantages of versatile Barber-Greene conveyors.

110 POWER DRAG SCRAPERS

Sauerman Bros., Inc. The booklet describes and illustrates details of many complete power drag scraper machines suitable for various applications. The machines described will meet the requirements of most jobs on which this type of machinery can be used to economical advantage.

111 POWER GRADERS

Austin-Western Co. A 24-page catalog AD 2112 pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

112 PRECISION-BUILT CEMENT FLOORS

Kalman Floor Company, Inc. An illustrated 8-page catalog describes the Kalman process, a precision method of building in maximum hardness and density uniformly over complete floor areas. The laying of one of these granolithic cement floors in a typical plant shows in detail the under-slab preparation, preparation of proper aggregate, Kalman topping mix, absorption control, compacting, surfacing, troweling and curing.

Turn to page 104 and order your literature.

Theory of ELASTICITY and PLASTICITY

By H. M. Westergaard
Late Gordon McKay Professor of Civil Engineering Harvard University

This newly published book presents much of the celebrated author's own original work that is not available elsewhere. It provides the practicing engineer with an up-to-date history of elasticity and plasticity, develops most of the solutions from the basic equation of elasticity, uses vector notation in the development of mathematical relations, emphasizes three-dimensional problems to a greater extent than any other book, offers a collection of three-dimensional problems dealing with forces acting on extended or semi-infinite solids not published elsewhere.

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This new, completely revised edition of a book that has been widely used since 1929 will be welcomed by today's roadbuilders. It presents the theory and practice of highway curves with emphasis on improved methods of surveying, location, geometric design and earthwork. Offering simplified design methods geared for greater precision, speed and flexibility, the book is unusually accurate in its detailed directions for field procedure. Much of the material in this new 4th Edition is new and all of it has been thoroughly edited to include all important recent advances in highway construction.

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CATALOG DIGESTS

113 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc. An informative 44-page brochure combining a catalog and calculating chart has been prepared. Pictured in four colors on the cover is the Berger Type R transit, one of the many instruments produced by the 81-year-old firm. On the center spread are photographs and code names for 12 types of Berger instruments, from an 18-in. dumpy level to a plane table alidade.

114 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc. Complete specifications on the Berger "N" line of moderate priced builders' instruments are included in an illustrated brochure now available. Companion line to the company's engineering, mining and astronomical instruments, the "N" line consists of a convertible transit-level, a 12-in. heavy-duty dumpy level, a service transit-level (farm level) and a hand level.

115 PRECISION INSTRUMENTS

Berger Scientific Supplies, Inc. 36 precision drawing sets, triangles, protractors, T-squares, curves, slide rules and scales are illustrated and described in a brochure. The Berger drafting kit, which combines all necessary draftsman's instruments and supplies in one easy-to-carry case, is also illustrated.

116 PRECISION LEVELS

Trans-Global Company. A 6-page folder gives photos and specifications of F-S precision level Model 5165, with split bubble reading, 180-deg reversion sleeve, minute-reading horizontal circle, and levelling accuracy of .012 ft per mile; F-S normal level Model 5155, with vertical protection bubble, minute-reading horizontal circle, and levelling accuracy of .03 ft per mile; F-S quick levels Model 5197, with 6-min horizontal circle, and Model 5191, both with vertical protection bubble.

117 PRESSURE-CREOSOTED PILES

Koppers Co. A 16-page booklet designed to assist engineers in the evaluation of pressure-creosoted foundation piles for various types of construction projects has been issued. The booklet cites important national, regional, and city construction codes which allow pressure-creosoted wood foundation piles for permanent construction. Typical examples of the use of these piles are described and pictured.

118 PRESSURE GROUTING INFORMATION

Gardner-Denver Co. offers Bulletin P-60 on pressure grouting information. Construction details of the Duplex high pressure steam pumps for grouting service, stationary air compressors and hand held drills are given, and are supplemented with charts, diagrams and illustrations and other informative matter.

119 PROCESS OILS

Borne, Scrymser Company has a brochure listing their principal products which may be segregated into two main classifications, process oils and industrial lubricating oils and greases. There is a separate section on recommendations for lubricating oils and greases and one on the use and application of industrial process oils.

120 PUBLIC ROADS OF THE PAST

American Association of State Highway Officials offer something new in engineering literature. A reprint of the Old Road Builder series from the pages of "American Highways" from April, 1944 through 1949, complete with bibliography. Included among many other items is history of development of roads, construction methods, surveying instruments, and methods of units of measure, from about 3500 B.C. to 1800 A.D. A publication every engineer should have, not only as a reference, but also for pleasant reading. Illustrated. Priced at $3.00 each.

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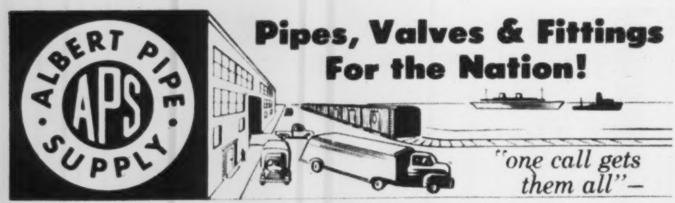
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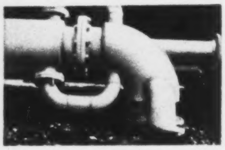

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CATALOG DIGESTS

121 PUMPS

Economy Pumps, Inc. A 148-page data book, 4¾ in. by 8½ in., with flexible binding, contains general information on centrifugal pumps, principles of pump engineering, general engineering data and selection tables on centrifugal, axial and mixed flow pumps. This book is priced at $3.00.

N. B. There is a charge for this book. Make checks payable to Economy Pumps, Inc.

122 PUMPS

Layne & Bowler, Inc. has a 16-page booklet entitled "Layne Short Coupled Service Pumps" for cooling towers, circulating or process pumping, lake and river intakes, boosters, fire pumps, drainage, pipe line boosters, and de-watering. Numerous photographs and sketches are included.

123 PUMPS

A. O. Smith Corp. Three bulletins are offered on various types of pumps of varying capacities. Features such as fabricated all-steel head and the especially designed Smith-built motors are explained. The bulletins are completely illustrated and include details of component parts and design and construction features which insure long life and operating economy. Capacities described range from 30 to 5000 gpm.

124 RAILS & TRACK ACCESSORIES

L. B. Foster Company recently released Bulletin A-158, "Rails & Track Accessories," a condensed 6-page bulletin illustrating examples of the complete stocks of track accessories and tools which are available from stock at Foster's warehouses.

125 RAILS AND TRACK ACCESSORIES

L. B. Foster Company is offering a complete 124-page catalog providing easy reference for simplified selection of rails and track accessories. All rail in general use is illustrated in full size cross section and equipment such as angle bars, tie plates, frogs, turnouts, crossings, and maintenance tools are clearly illustrated and their applications described. The most extensive and complex list of track materials can be made up easily and efficiently using this new revised edition. When writing specify Rails and Track Accessories Catalog No. 575.

126 RECTANGULAR STEEL FLOORING

Kerlow Steel Flooring Co. An informative folder is complete with illustrations, blueprints, charts and descriptive matter on the strongest steel bridge flooring that Kerlow has ever made. IG-35 is made with grating parallel with traffic and also transverse to traffic.

127 RENTING STEEL SHEET PILING

L. B. Foster Company. Advantages of renting steel sheet piling are described in an 8-page brochure. Specifications for the interlocking piling sections as well as corners and connections of the three leading manufacturers of steel sheet piling are presented. Foster pile hammers and extractors are described.

128 ROCK BORING MACHINE

The Salem Tool Co. A booklet on the McCarthy rock boring machine is offered. Detailed construction and top-quality materials are outstanding features of the stronger, faster, more economical machine. Many time-saving, labor-saving advantages such as "drilling 40 percent more holes per day" and boring up to 12-in. diameter holes to depth of 150 ft in any earth formation are listed. Numerous photographs of the machine are included.

129 SCRAPER BUCKETS

Sauerman Bros., Inc. The various standard types of Sauerman Crescent scraper buckets as well as a few Crescents of special design are illustrated and described in a booklet. Typical uses of this equipment are depicted by a number of action photographs chosen from thousands of photographs received from Sauerman customers all over the world.

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CATALOG DIGESTS

130 SEWAGE PUMPS

Worthington Corporation A 4-page bulletin No. W-317-B12 describes Worthington types FLI and FLID wet pit pumps used in handling sump sewage and for drainage service.

131 SEWAGE REGULATORS

Brown & Brown, Inc. Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems either by cutting off such flows entirely during storm periods or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

132 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company A general description of the complete line of Simplex equipment is offered in Bulletin 003. The Bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controllers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment, air inlet and air release valves.

133 SLACKLINE CABLEWAY EXCAVATOR

Sauerman Bros., Inc. A 28-page catalog tells where to use, when to use, and cost of using the slackline cableway excavator which digs, conveys, elevates and automatically dumps materials, all in one motion. Explains graphically the particular advantages of this machine for digging in marshes, bogs and under water. Over one hundred photographs and sketches of machines at work in gravel pits, clay pits, open pit mines, digging reservoirs, making earth dams, reclaiming waste piles, cleaning out ponds, etc. The rapid shifter device is described, also the tubular steel masts and machines with movable towers.

134 SPECIFICATIONS INDEX

The American Brass Company A revised edition of "Copper and Copper Alloy Specification Index" has been released. The index provides up-to-date specifications of the various national engineering societies and government agencies, including "Military," Munitions Board, Department of Defense. The 28-page publication is divided into two sections. The first lists the most generally used copper alloys together with the applicable specifications of nine different agencies. The second lists specifications in numeric order with a brief description of the material as to alloy, grade, type, temper, anneal, etc.

135 STEEL BEARING PILES

United States Steel Co. A 100-page book presents comprehensive data and illustrations of the current practice in the design and use of the new steel CBP section bearing piles. In addition, there is an extensive review of the use of steel bearing pile sections, with records of tests of the past, uses and applications.

136 STEEL FORMS

Economy Forms Corp. A booklet on steel forms for concrete construction is offered. It has numerous pictures showing the simple handling, applications, and use of the forms for all types of heavy construction: tunnels, culverts, sewage & water treatment plants. Special forms designed to solve concrete construction problems are also shown.

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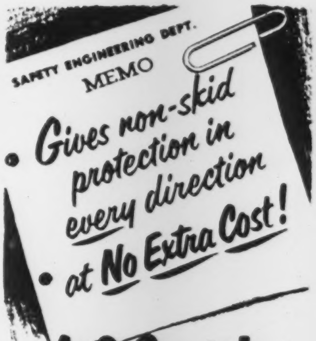
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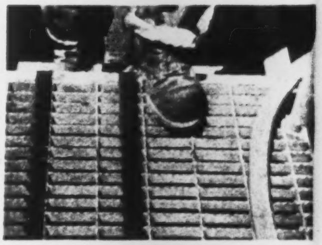

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137 STEEL SHEET PILING

United States Steel Co. A 56 page booklet gives detailed discussion of the uses, characteristics, and assembly of the three general types of steel sheet piling sections: the straight web, the arch web, and Z piles. Following this discussion are complete tables of wall dimensions, cellular structures, accessories, and weights for all sections, plus diagrams of the individual sections, walls, corners, cellular structures, cofferdams, bulkhead and piers, and caps or copings.

138 STRUCTURAL ENGINEERING

Menat Trading Corp. A list of selected books for structural engineers written in English and published in Europe. The list gives a description of books on the theory of structures, soil mechanics, the design of industrial and commercial steel structures and the analysis and design of reinforced concrete roofs of thin shell construction.

139 STRUCTURAL SHAPES

United States Steel Co. Attractive 72 page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails and corrugated sheets.

140 SURVEYING ALTIMETERS

Wallace & Tiernan Products, Inc. Modern methods of altimetry or barometric leveling and a complete line of surveying altimeters are described in the "Altimetry Brochure." Also available upon request is a plastic rule which provides the temperature and humidity correction factor, for altitude and also scales in sixteenths and twentieths of an inch.

141 SURVEYING INSTRUMENTS

Carl Heinrich Company offers catalogs and literature covering its line of builders' and engineers' instruments and supplies. These include a specification sheet on the Sokkisha transits, for which the company is exclusive New England distributor; David White Bulletin 1052; price list on leveling rods; and complete details of rental and repair service. Inquiries limited to New England area.

142 SURVEYING INSTRUMENTS

Warren Knight Co. The 56 page 10th Edition of the company's catalog of precision transits, levels, clinometers, protractors, etc., and a general line of engineering equipment and supplies is now available for distribution to engineers without charge or obligation.

143 SURVEYING INSTRUMENTS

David White Company offers Bulletin 1052 on surveying instruments for all purposes. The present edition tells the story of the most recent changes and developments in the field of surveying instruments and engineer's field supplies. The catalog presents an exceptionally large assortment of high grade and up to the minute products.

144 SURVEYORS' STAKES

Angelina Hardwood Sales Company has a stake list describing their six standard models available in any quantity and in lengths from 8 in. to 36 in.

145 TANDEM ROLLERS

Galion Iron Works & Mfg. Co. Catalog No. 325 on variable weight tandem rollers is offered. The many improvements in construction and operation are fully described and illustrated. Complete specifications are also listed.

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TIDE GATES

Fig. B-68. Type M (Circular) Gate

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CATALOG DIGESTS

146 TECHNICAL BOOKS

John Wiley & Sons, Inc. Information on authoritative, up to date technical books in all branches of science and engineering is available in the Wiley general catalog. Of particular interest to civil engineers are the descriptions of standard reference and textbooks on structural engineering, foundations, hydraulic and hydroelectric engineering, municipal engineering, architecture, irrigation, highway and bridge engineering, building construction, and many other related subjects.

147 TECHNICAL DATA SHEETS

Lefax offers their latest data list in which are listings of approximately 2,000 loose leaf data articles on various subjects. Weights and measures, mathematics, materials of engineering and construction, civil engineering and construction, surveying, etc., are only a few of the many subjects listed.

148 TENSIONING UNIT

Stressteel Corporation. A 64-page manual describes a new large diameter steel bar pretensioning unit for prestressed concrete. This manual provides basic background information, design data, construction procedures, materials description, specifications, etc. The use of Stressteel tensioning units and the economics and advantages of this type of prestressed concrete construction are fully described.

149 THEODOLITE

Geo-Optic Company, Inc. has a leaflet describing the optical universal theodolite 4-50 with terrestric telescope (erecting eyepiece). The 150 enables surveyors to cope with any possible problem of triangulation and to obtain results of the highest accuracy. All readings are done from one position—an important time factor. Other advantages and data are included.

150 THREE-WHEEL ROLLERS

The Galion Iron Works & Mfg. Co. An attractive four color catalog No. 294 describes the company's three wheel rollers. Complete specifications are given together with detailed description and photos of the many construction and operation features.

151 TIDE GATES

Brown & Brown, Inc. Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

152 TRACING PENCIL TEST KIT

American Lead Pencil Co. The kit contains samples of Venus tracing pencils for testing on various types of tracing papers. This new pencil contains an active chemical to produce clearer, sharper white or blue prints when reproduction is made from a pencil drawing.

153 TRACTOR

Caterpillar Tractor Co. With detailed illustrations, "High Production with the Cat DW20" takes the reader on a trip across the continent to visit large scale construction, mine and quarry jobs. The earthmoving rigs of well known equipment users are pictured in operation. Each picture includes the four wheel DW20 prime mover described as having 225 horsepower available at the flywheel. Included in the booklet is such DW 20 equipment as the Caterpillar W20 wagon, No. 20 scraper and Athey PD20Q trailer.

154 TRANSIT CRANE

Bucyrus-Erie Co. a 12 page bulletin attractively printed in two colors, describes, through photographs and text, the 22 B crane excavator with rubber tired transit crane mounting. The 22 B transit crane features easy mobility, precision control, hinged crane boom for easy carrying in transit, and a mounting built exclusively for Bucyrus Erie.

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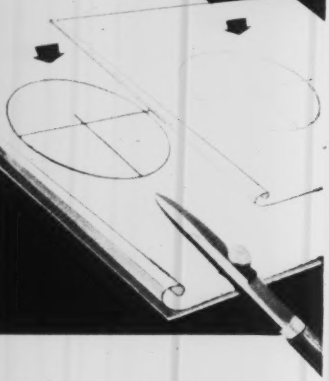

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155 TRANSIT-THEODOLITE

Trans-Global Company. A 16-page catalog on the 6-sec transit theodolite, Model 4150-R, explains optical plummet, optical reading, and repeating lever. It describes the carrying case, tripod, normal accessories and special accessories. Catalog T-1 covers operating instructions, constructional details, specifications and instrument adjustments and is completely illustrated with photos and diagrams.

156 TUNNEL CONCRETING

Mayo Tunnel & Mine Equipment has prepared a bulletin No. 16 which illustrates and describes "Placing Trains" and "Mixing Placing Trains" for concrete lining of tunnels. The company also has a wall chart for conversion of meters to feet and inches. This is available to engineers who are working in or with foreign countries.

157 TUNNELING

Commercial Shearing & Stamping Co. Now available is a text book on tunnels and an introduction to tunnel geology by tunnel men. Entitled "Rock Tunneling with Steel Supports" by Karl Terzaghi, the book deals with specific information on tunneling, covering 300 subjects. The most comprehensive book of its type ever offered to the tunnel builder and designer. Price $2.50 per copy postpaid.

N. B. There is a charge for this book. Make checks payable to the Commercial Shearing & Stamping Co.

158 UNDERPASSES

Armco Drainage & Metal Products, Inc. A 16-page booklet, "Manual of Underpasses, Tunnels and Conduits," describes the safety, convenience and economy of these structures. It covers various types of corrugated metal structures, sizes and shapes, and illustrates typical applications. Useful tables are included, also data on underpasses for pedestrians and livestock, conveyance tunnels, service tunnels and conduits. Other sections describe methods of obtaining openings, field construction service, and finishing and equipping.

159 VENTURI METER

Simplex Valve & Meter Co. Bulletin No. 401 describes in detail the operation and installation methods of the type H meter register. This is a circular type chart instrument equipped with various forms of mountings and arranged for operation under the majority of hydraulic head conditions. A complete pipe size and meter capacity table provides a quick and ready reference when needed. This bulletin is of essential interest to any filter plant or sewage plant designing engineer.

160 VIBRATORS

Viber Co. New applications and equipment development on interchangeable vibrator units, flexible drive, full depth internal concrete paving, rubber tipped and Model PX-6 external vibrators are described in a recently published catalog. Specifications concerning speeds, weights, sizes, types of power, etc., are included.

161 WALL-FORM CONSTRUCTION

Symons Clamp & Mfg. Co. has available for immediate distribution a 44-page catalog on its system of wall form construction. It has all of the latest information and improvements in the Symons forming system. Illustrations show in detail how simply and easily the forming system operates. Actual construction where Symons forms have been used are well illustrated, showing the forms in use as well as completed jobs. Also blueprint illustrations and complete specifications are given, material and equipment necessary, time required and cost figures on actual jobs. For added convenience, the new catalog also contains detailed information on Symons safety shores and column clamps.

162 WATER CONDITIONING

The Permutit Company. Pocket-size Data Book No. 2478A is compiled for the convenience of practicing engineers and those who work with water conditioning problems. The 102 pages of invaluable data is bound together in a leatherette cover and gold stamped.

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CATALOG DIGESTS

163 WATER DAMAGE CONTROL

Western Waterproofing Co. A practical professional treatise illustrated with case history photos covers all phases of preventive remedial and restorative treatment of both old and new structures.

164 WATER FILTERS

Proportioneers, Inc. Bulletin 1800 describes Pur O Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specifications and dimensions covering the complete recirculation and purification systems, are given.

165 WATERPROOFING

Western Waterproofing Co. has a comprehensive guide showing how to protect both new and old structures from above grade water penetration with Resto Crete system and Dilato expanding mortar; interior wall dampness with Parge coat; sub-surface water seepage with Ironite. Detailed data and sample specifications for these services are included.

166 WATERPROOFING

Western Waterproofing Co. A well illustrated folder explains the most effective methods of protecting masonry walls from water damage and dampness, by the "parge" system for interior surfaces and their application of "dilato" expanding mortar to exterior joints.

167 WATER PURIFICATION

Worthington Corporation. A 6 page bulletin No. W 212 B4 describes the operation of a Worthington ion exchange water purification system, and illustrates the equipment furnished for the process.

168 WELDED FABRIC

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp. A 2 color folder describes Clinton electrically welded fabric which has been successfully applied to every form of reinforced concrete construction. Some of its many uses are for concrete roads, streets, airports, floors, pipe, sewers and reservoirs. Structural advantages, ease of use and standard styles are listed.

169 WELDED GRATING

Klemp Metal Grating Corp. A new type of open steel welded grating is announced in a 24 page "Open Steel Grating and Stair Tread Catalog." It is fully illustrated and complete with engineering data, charts, and a safe load table for welded and diamond riveted grating.

170 WELDED STRUCTURES

Lincoln Electric Company offers a series of case studies of modern welded structures which exemplify the best in welded design fundamentals. The current study is a review of six recently erected welded buildings ranging from office buildings to apartment houses. Other studies recently presented include a 5 span, 180 ft highway bridge, a study of welded joint details and the rigid frame design.

171 WELLPOINT DEWATERING

Complete Machinery and Equipment Company has a catalog entitled "Dewatering the Complete Way." The catalog has been published for the sole purpose of showing the ease of installation, operation and maintenance of "Complete" wellpoint systems. Included in the catalog are many pictures of dewatered construction areas where construction "in the dry" has been accomplished as well as diagrammatic sketches of proper location of wellpoint equipment to handle sub-surface water on various types of construction projects.

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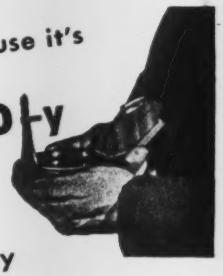

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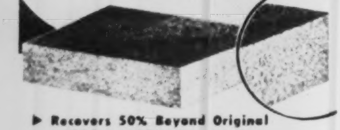

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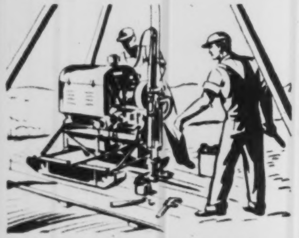

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CATALOG DIGESTS

172 WELLPOINT DEWATERING SYSTEM

John W. Stang Corp. A catalog describes the component parts of the Stang wellpoint dewatering system, its planning, engineering and various methods of installation. Specific installations on dams, power houses, pipelines, tunnels, etc., are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

173 WELLPOINT SYSTEM

Griffin Wellpoint Corporation. Photographs and line drawings in "Griffin Pointed Wellpoint Facts" describe typical wellpoint layouts and case histories for sewage works, industrial structures, power plants, etc. Several pages are devoted to jetting pumps for installing the wellpoints. Larger jetting units are illustrated for jetting piles, sheeting, caissons and other jetting purposes.

174 WELLPOINT SYSTEM

Griffin Wellpoint Corporation. "The Wellpoint System in Principal and Practice" is a comprehensive practical text published to meet requests for a digest of the basic principles of wellpoint systems and their application to dewatering wet excavations. The components of a wellpoint system and the fundamentals of planning, installing and operating the system are discussed and illustrated in detail. There is a charge of $1.50 per copy.

N. B. Booklet free to Contractors and Engineers if requested on letterhead and directed to Griffin Wellpoint Corporation, 881 East 141st St., New York 51, N. Y.

175 WELLPOINT SYSTEM

Moretrench Corp. "Working in the Dry with the Moretrench Wellpoint System" is the title of a 64-page catalog describing and illustrating the Wellpoint system and its use in dewatering various types of construction projects. It is amply illustrated with on the job photos.

176 WINCHES AND HOISTS

Pacific Car and Foundry Company has a complete file of literature and specifications sheet on Carco winches and hoists for all makes of industrial tractors and Carco cable and hydradozers. Interested parties should state the type of equipment in which they are interested, together with the makes and models of their tractors.

177 WIRE ROPE

American Steel & Wire Co. A 40-page wire rope recommendation book is offered. It contains recommendations for efficient and economical types of wire rope to be used in the various fields of service. Prepared as an aid in securing longer wire rope life.

178 WIRE ROPE

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp. The new Wickwire rope catalog offers a different approach to this difficult subject. Charts, tables, drawings, and photographs were included to present a fresh slant on wire rope. The catalog covers the characteristics, care, handling and describes wire rope for specific industries.

179 WIRE ROPE—LIFE AND COSTS

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp. Thousands of wire rope users, old hands and new, have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

180 MASTERPLATE FLOORS

The Master Builders Co. A 36-page booklet gives full information on product and method for producing the Masterplate "iron-clad" concrete floor. For new floors and resurfacing. Features of the Masterplate floor: 4-6 times more wear resistant than a plain concrete floor, spark-safe, non-dusting, non-slip, corrosion resistant, easy-to-clean and economical. Full information on nine features of the floor, specifications and detailed directions are included.

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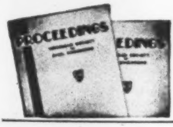

PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues, other titles will be added every month, as they become available. Use the convenient order form on page 128

Summarized in Earlier Issues

D-87. Discussion of Paper, **Sewage Reclamation by Spreading Basin Infiltration,** by Ralph Stone and William F. Garber.

D-92. Discussion of Paper, **Experimental Investigation of Fire Monitors and Nozzles,** by Hunter Rouse, J. W. Howe, and D. E. Metzler.

D-96. Discussion of Paper, **Surface Curves for Steady Nonuniform Flow,** by Robert B. Jansen.

D-100. Discussion of Paper, **Forced Vibrations of Continuous Beams,** by Edward Saibel and Elio D'Appolonia.

Third Notice

142. **Unconfined Ground-Water Flow to Multiple Wells,** by Vaughn E. Hansen. The purpose of this paper is to clarify the nature of unconfined flow to single and multiple wells, and to present a method of solving problems associated with this type of flow. The effect of the capillary fringe on the location of the free surface and the form of the flow patterns, the zone of validity of the Dupuit equation, the shape of the free surface near the well, and the variation in the stream-surface spacing are all discussed. A functional relationship independent of the radius of influence is established, relating the variables at the well, this relationship applies to both single and multiple wells. A fundamental dimensionless parameter consisting of a ratio of Froude's to Reynolds' number is formulated that characterizes the shape of the cone of depression around a well. The concepts of well efficiency and effectiveness are clarified and guides are presented for their correct use. (Available September 1.)

143. **Electrical Analogy in Problems of Three Dimensions,** by P. G. Hubbard and S. C. Ling. Engineers whose work includes the design of low-loss transitions of air-conditioning systems, water-supply systems, or hydraulic outlet works will be particularly interested in the experimental methods and typical results presented in this paper. The principles involved are analogous to those of the flow net or relaxation methods already used for two-dimensional work, but the requirements of symmetry about one axis are removed. An inexpensive, versatile tool of high accuracy is the result. (Available September 1.)

144A.

144B. **Aerodynamic Stability of Suspension Bridges, Progress Report of the Advisory Board on the Investigation of Suspension Bridges.** The aerodynamic forces which act on a bridge in the wind, and the occurrence of resonance of the motion, depend on the velocity and direction of the wind and the size, shape, and motion of the bridge. The amplitude of oscillation depends on the strength, variation, and duration of wind forces and the energy storage capacity and damping of the structure. The remaining unknown factor is supplied by a test that relates the motions of a dynamic section model to a properly scaled wind. Means are discussed of designing a bridge which will be safe against objectionable oscillation in the wind. Because of its length (63 pages), this paper is rated as two Proceedings-Separates, and priced accordingly. (Available September 1.)

145. **Torsion of I-Type and H-Type Beams,** by John E. Goldberg. Beginning with a review of pure torsion and torsion bending of I-type and H-type sections, the basic differential equation is obtained for the twisting of such sections. The stresses resulting from twist—namely, the simple torsional stresses and longitudinal and shearing stresses due to warping restraints—are discussed from the engineering standpoint. Particular solutions of the differential equation are obtained for various warping conditions at the ends, and it is shown how these solutions are combined to formulate and analyze various problems, including that of a framed floor panel. (Available September 1.)

146. **Electrical Analogies and Electrical Computers: Surge and Water Hammer Problems,** by Henry M. Paynter. This paper describes the basis for the application of electrical-hydraulic analogies and electronic analog computers to problems in hydraulic transients. Water hammer studies in a uniform pipe and surges in a simple tank are discussed in some detail. In addition to promoting understanding of the underlying phenomena of unsteady flow, analog techniques are demonstrated as furnishing formulas capable of practical applications. (Available September 1.)

147. **The Delaware Memorial Bridge: Design Problems,** by Charles H. Clarahan, Jr., and Elmer K. Timby. One of the major suspension spans thus far constructed, this bridge emphasized the need for knowledge of the behavior of such structures in order that maximum economy in design may be attained. The provisions for torsional resistance in this bridge include a double lateral system. Design specifications are discussed in some detail. The solutions to problems inherent in the particular foundation conditions encountered are explained. Correlation of the design with model tests has proved helpful and these tests are being continued. (Available September 1.)

D-84. Discussion of paper, **Longitudinal Mixing Measured by Radioactive Tracers,** by Harold A. Thomas, Jr., and Ralph S. Archibald. The original paper, published in August 1951, presented a method of determining the magnitude and effect of horizontal mixing

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in pipes and tanks as available to the engineer through the use of radioactive tracers. Discussers are: Conrad P. Straub and Donald A. Pecsok, Alfred C. Ingersoll, Harold A. Thomas, Jr., and Ralph S. Archibald. (Available immediately.)

Second Notice

148. **Bank Stabilization by Revetments and Dikes,** by Raymond H. Haas and Harvill E. Weller. Aggravated by wide variations of hydrographic and physiographic elements, the problem of bank stabilization on the Lower Mississippi River has been found to be extremely complex. The solution of the problem is not wholly a matter of applying hydraulic formula nor is it simply a proposition of adopting structural design that has proved successful elsewhere. This paper presents the problems encountered and the evolution in the design of structures employed to modify the primitive stream for the purpose of securing effective flood control and navigation. (Available October 1.)

149. **Industrial Waste Treatment in Iowa,** by Paul Bolton. Problems involved in the handling of industrial wastes contain phases peculiar to a given region, but many such problems are common experience everywhere. As in most of the states, this question has been of major concern for a number of years in Iowa, and is presented herewith to a larger audience as a challenge toward more generalized solutions. (Available October 1.)

150. **East St. Louis Veterans Memorial Bridge,** by A. L. R. Sanders. Some of the problems encountered in designing this bridge were of particular interest and importance. Their solution and the design procedure in connection therewith are explained. The cantilever river span is believed to be the longest of any span crossing the Mississippi. The AASHO specifications were departed from in the design of compression members and in determination of the wind load requirements on long spans. Other special features in the design were the bridge shoes, the floor beam hangers, and provisions for the lateral bending of floor beams. (Available October 1.)

151. **Topographic Mapping in Kentucky,** by Phil M. Miles. Modern methods of topographic mapping have been employed in an unusually extensive cooperative program between the Commonwealth of Kentucky and the United States Geological Survey. This paper describes the historical and technical facts which determined the techniques and specifications used. Use of the equipment and the filing and distribution of topographic data, with emphasis on the value of by-products, is explained. The work in Kentucky is of particular interest to engineers or State officials considering topographic mapping in their own state. (Available October 1.)

152. **Methods for Making Highway Soil Surveys,** by K. B. Woods. Important developments and refinements in methods for making highway soil surveys include the use of agricultural soil-survey maps, certain types of geologic maps, and air photos. Resistivity methods and seismic methods are useful for obtaining additional detailed information. Knowledge of geology, pedology, and aerial photography is important in interpreting the data obtained from these sources. The future need for specialists, trained in the new techniques, is foreseen as applying particularly to soils sections of the larger highway departments. (Available October 1.)

153. **Characteristics of Fixed-Dispersion Cone Valves,** by Rex A. Elder and Gale B. Dougherty. This paper reports the results obtained from field tests on five Howell-Bunger type valves that have been installed by the Tennessee Valley Authority. A usable method is described for obtaining accurate discharge ratings with a minimum discharge through the valves. Rating curves and discharge coefficients are given. The results of measurements of the air required to vent these valves are supplied and the effects of the dissipating structures that surround the valves lead to the formation of ideas of the mechanics of air demand. (Available October 1.)

First Notice

154. **A Navigation Channel to Victoria, Tex.,** by Albert B. Davis, Jr. This paper explains the authorization of a Federal barge channel and describes the planning of the channel prior to construction. The planning involves studies of both a lock canal and a sea-level canal, and requires a comparison of the engineering and economic features involved in the two types of navigation improvement. The problem of water supply for operation of a lock canal is investigated, and the effect of an insufficient water supply on design of a navigation channel shown. (Available November 1.)

155. **Field Study of a Sheet-Pile Bulkhead,** by C. Martin Duke. Measurements of soil pressure, tie-rod tension, and deflection were made during and after filling behind a bulkhead retaining a 55-ft fine sand fill. During filling, soil pressure on the bulkhead was proportional to the weight of overlying fill, in the ratio of about 0.7. After completion of filling, partial support of fill on the tie rods and anchor system was found to redistribute markedly the soil pressures. The results are interpreted in the light of special conditions, such as the presence of a granular dike. (Available November 1.)

156. **Rice Irrigation in Louisiana,** by E. F. Shutts. Interesting and valuable data on one important type of irrigation are offered for discussion in this paper. The author presents a brief history of rice irrigation throughout the world as a background for a detailed discussion of procedures followed in Louisiana. (Available November 1.)

D-78. Discussion of Paper, **River Channel Roughness,** by Hans A. Einstein and Nicholas L. Barbarossa. This paper, published in June 1951, discusses the total friction developed on the alluvial bed of a natural river which can be described as the sum of a "surface drag" and of a "shape resistance." Discussers are: T. Blench, James J. Doland and Ven Te Chow, Robert B. Banks, L. Bajorunas, and Sir Claude Inglis. (Available immediately.)

D-109. Discussion of Paper, **Final Foundation Treatment at Hoover Dam,** by A. Warren Simonds. The original paper, published in December 1951, described the unprecedented height of Hoover Dam with the extremely high head of water against the foundations and abutments which created problems in design that were not subject to exact analysis. Discussers are: James B. Hays, V. L. Minear, Byram W. Steele, William H. Alpine, Fred H. Lippold, O. F. Boggess, H. Cambefort, and A. Warren Simonds. (Available November 1.)

D-113. Discussion of Paper, **Wave Forces on Breakwaters,** by Robert Y. Hudson. This paper, published in January 1952, reviewed the two principal types of breakwaters: (1) Vertical-wall structures and (2) those with sloping faces constructed of rubble. Discussers are: Kenneth Kaplan, R. G. Hennes and C. E. Leonoff, and Robert Y. Hudson. (Available December 1.)

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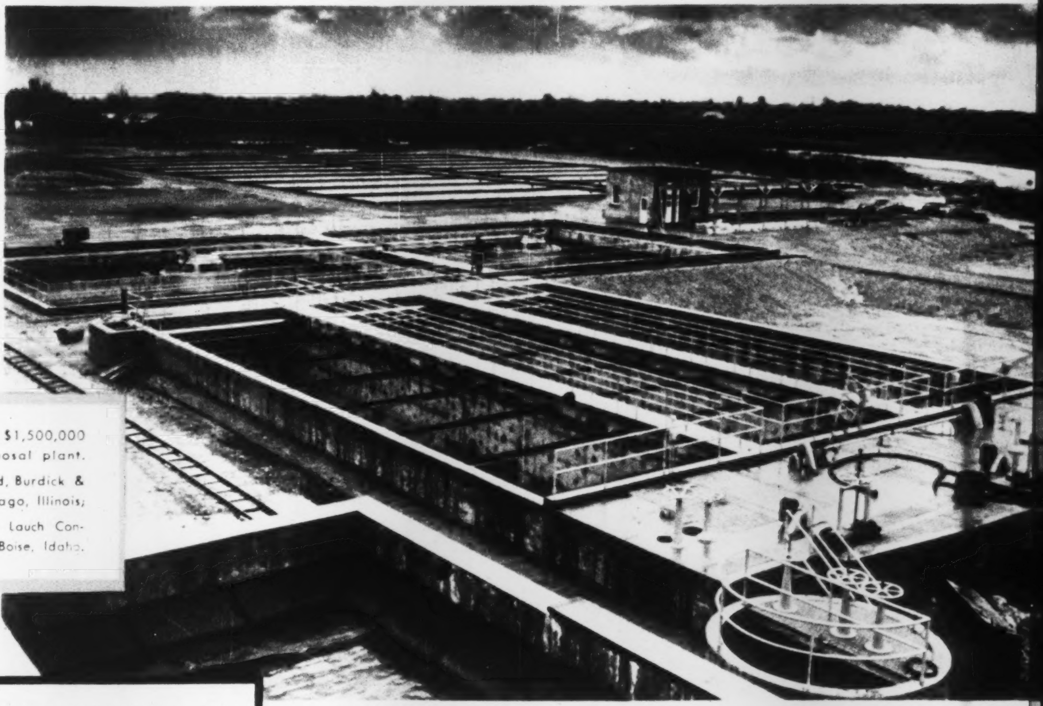

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